THURSDAY, JANUARY 10, 1884

AMERICAN GEOLOGY

Twelfth Annual Report of the United States Geological and Geographical Survey of the Territories. In Two Parts, with Atlas of Maps, &c. By F. V. Hayden, U.S. Geologist. 8vo. (Washington: 1883.)

THERE is a singular fascination in American geology. Its features are as a whole so massive and colossal, their infinite detail so subordinated to breadth of effect, their presentation of the great elements of geological structure so grand, yet so simple and so clearly legible, that they may serve as types for elucidating the rest of the world. The progress of sound geology would assuredly have been more rapid had the science made its start in the Far West of America, rather than among the crumpled and broken rocks of Western Europe. Truths that have been gained on this side of the Atlantic by the laborious gathering together of a broken chain of evidence would have proclaimed themselves from thousands of plateaux, cañons, and mountain ranges, in language too plain to be mistaken. No doubt much has been gained by the mere toilsomeness of the search after the truth. A possession is more valued when it has been hard to obtain, and the qualities which its capture has called forth and strengthened could probably be educated in no other way. Nevertheless, no European geologist can visit these western regions without realizing more or less distinctly what an amount of time has been wasted here over questions about which there should never have been any discussion at all. This impression is renewed by every new geological memoir which brings to us fresh revelations of the scenery and structure of the Western Territories. It is especially deepened by a perusal of the volumes of which a brief notice will here be given.

It may be in the recollection of readers of NATURE that after some inquiry and discussion it was discovered by the Congress of the United States that various independent Surveys, under different Government departments, had been engaged among the Western Territories, and, having no connexion with each other, had, to some extent, duplicated the mapping of the same ground; and that at last in the summer of 1879 a law was passed whereby these various geological and topographical Surveys were abolished, and a new single organization was created under the name of the "Geological Survey of the United States." One of the Surveys thus abolished was known as "the U. S. Geological and Geographical Survey of the Territories," under Dr. F. V. Hayden as Geologist in charge. The publications of this Survey comprised a voluminous series of annual Reports and Bulletins, quarto volumes of elaborate and well illustrated Memoirs, and Geological Maps and Sections. Many thousands of square miles of country had been examined by the staff, and had been mapped and described in such a way as to lay out the broad features of wild regions for the first time, not only for the assistance of the geologist or geological surveyor who might afterwards care to fill in the details and improve the mapping, but for the guidance of future settlers in the far west, and of the Central authorities who have charge of the public lands. When, at the bidding of Congress, Dr. Hayden's Survey organization ceased to exist and his staff dispersed in search of other occupations, the work done in the year 1878 had not been published, while several important works were in progress. A small appropriation was granted to enable him to bring out his last Report and to complete other office-work of the Survey. This grant was exhausted in the summer of 1882, leaving five quarto volumes still unpublished though far advanced towards completion. These have been handed over to the Director of the Geological Survey, to be finished and published under his auspices. The final Annual Report, however, being the twelfth of the series, has at last been issued, the delay in its appearance having arisen from the scattering of the staff and their employment in other avocations, but partly perhaps (though he makes no mention of it) to the prolonged indisposition under which Dr. Hayden has been labouring ever since his retirement from official life.

Dr. Hayden's Report for 1878 is a most fitting termination to the series which it closes. It consists of two massive octavo volumes with an atlas of Maps and Panoramas, and is profusely illustrated with plates. It is of course impossible to give any adequate notice of this elaborate work within the limits permissible in these pages. But a mere outline of its contents may afford some idea of the nature and importance of this latest contribution to American Geology.

The first volume opens with a Prefatory Letter from Dr. Hayden himself, stating briefly the arrangement o the work under his supervision during the last year of its progress. One of his parties was charged with the primary triangulation of the entire area to be surveyed, and made satisfactory progress, among the Wind River and adjacent ranges westwards to Henry's Lake, where its operations were unfortunately cut short by Indians who crossing its trail, carried off all its animals and a portion of its outfit. Not far to the north lay the Yellowstone Park—an area perpetually exempted from settlement by special Act of Congress. That wild tract, surrounded by rugged mountains, formed a natural retreat for bands of hostile Indians when pursued by troops. Only the year before, the Nez Percés, retreating from General Howard, broke into the region, killing and plundering as they went. No wonder the surveyors should excuse any shortcomings in their work by pleading "that peculiar mental condition consequent on the uncertain and exaggerated rumours relative to the movements of the hostile Bannacks by whom the country was said to be overrun, but of whose presence we saw no more than the traces of some days' old trails." Next year, the writer of these lines, having previously heard similar wild rumours, passed over some of the same ground, but actually encountered an armed party, and will always remember the "peculiar mental condition," which the dust-cloud of the approaching red-skins awakened.

A second division of the staff made a detailed survey of the Yellowstone Park, obtaining materials for a Map of it on the scale of one inch to a mile. Mr. W. H. Holmes, attached to this party, had excellent opportunity for wielding that facile pencil to which geological science is so much indebted. Dr. A. C. Peale and Mr. Musbach made a detailed study of the thermal springs for which the region is now so famous.

A third division surveyed the previously little known but

magnificent snowy range of the Wind River Mountains, in which three true glaciers were observed—the first known to occur east of the Coast Range of the Pacific border.

The Report of these various surveys and of palæontological and natural history researches connected with previous explorations is divided into two parts. Taking the second part first, we have a stout volume of some 500 pages with 80 plates, besides figures, maps, and sections entirely devoted to the Yellowstone Park. A good deal has been written on the wonders of this region, chiefly in previous Reports of Dr. Hayden's Surveys, and sometimes in considerable detail, as, in Professor Comstock's Report, accompanying Captain Jones' Reconnaissance published in 1875. But no such minutely circumstantial narrative has ever appeared as that now issued.

An exceedingly erroneous general impression is conveyed by the word "Park" which has been applied to this region and which has received the sanction of an Act of Congress. The tract comprises an area of upwards of 3500 square miles, most of it being forest covered and of a rugged mountainous character. Some of the peaks rise to between 10,000 and 11,000 feet above the sea. Between the lower ridges, open glades of park-like woodlands make one half forget for a while the great altitude and remoteness of the region, till the true character of the place is recalled by some pine-trunk deeply scored by a passing bear or by a herd of "antelopes" or an occasional "elk" scampering across the sunshine into the gloom and silence of the surrounding forest. Through this region, the Yellowstone River and its tributaries, draining a series of lakes, flows northward till it enters a profound cañon in which, at times unseen and unheard, it chafes the feet of volcanic precipices until, emerging amid a series of glacier moraines, it passes out of the "Park" into the Territory of Montana.

The Monograph of this deeply interesting region now published by Dr. Hayden is composed of three unequal sections. The first of these, by Mr. W. H. Holmes, treats of the general geology. It is no disparagement to the author to say that the most valuable part of his Report is to be found in his admirable sketches. He adds some interesting particulars, indeed, to what was already known of the geology of the district. For example he has worked out in greater detail the structure of Cinnabar Mountain which forms so striking a feature in the ascent of the Yellowstone above the second cañon, likewise the geology of the remarkable volcanic plateau of which one sees a section from the camping ground at the Mammoth Hot Springs. The beautiful unconformability under the sheet of rhyolite which forms so impressive a feature in that landscape stands out with admirable clearness in Mr. Holmes' drawings. Evidence is supplied of the diminution of the Yellowstone Lake. A reference, tantalizingly brief, to the interesting glacial problems of the district concludes this short Report. The author was too well and busily employed with his pencil to find time for much independent geological observation. But it is matter for hearty congratulation that before he was moved away into the vaster domain of the Grand Cañons of the Colorado, where he has since done such service to the United States Geological Survey, he was enabled to spend long enough time in the Yellowstone region to produce the series of pictoral illustrations which enrich Dr. Hayden's final Report. His trained eye and power of rapid and accurate sketching greatly contributed to the perfection of the map of the Park.

The second and by much the longest section of the book is devoted to the Hot Springs of the Yellowstone Park, and is from the pen of Dr. A. C. Peale, who spent about two months in the district making detailed observations of the geysers and other thermal waters. He describes more than 2000 springs and seventy-one geysers, and illustrates his descriptions with so numerous a series of plates that every minute detail and variety of form in the geysers and sinter accumulations is vividly brought under the eye. Dr. Hayden justly remarks that this preliminary work ought never again to be necessary. Short of an actual inspection of the geysers and basins themselves, nothing could give a clearer idea than these plates do of the extraordinary forms assumed by the deposits from the thermal waters. The strange coralloid and sponge-like aggregations are excellently depicted in lithographs which have obviously been reproduced from photographs. Dr. Peale's Monograph consists of three parts, the first devoted to a description of the geysers and thermal springs; the second to an account of the principal geyser regions of the world for purposes of comparison; the third to thermo-hydrology, in which he discusses the general characters of thermal waters, their chemistry and deposits, and the theories of geyser action. The premature disbanding of the Survey prevented the completion of this essay on the scale originally intended. But Dr. Peale may be congratulated on having made a most useful addition to the literature of the subject. Not the least of its merits is the copious bibliography which is given in an Appendix.

The third section of the volume, by that able cartographer Mr. H. Gannet, deals with the topography, and gives an interesting *résumé* of the various reconnaissances and surveys which have resulted in the present detailed map of the Yellowstone Park.

The other volume, forming Part I. of the Report for 1878 is divided into two sections. One of these, relating to geology and palæontology, contains a series of Reports by Dr. C. A. White on the invertebrate palæontology of the Western States and Territories from the Carboniferous to the Tertiary rocks, and is accompanied by forty-two Plates of Fossils. Some sections have a special interest, in particular that in which the author discusses the fossils of the much disputed Laramie group, and sustains his previously expressed opinion that this group should be regarded as transitional between the Cretaceous and Eocene formations of the West. The abrupt cessation of the Survey, by depriving Dr. White of an opportunity of completing some of his work by further collection, has materially crippled him in the preparation of these further contributions to a subject which he has already done so much to elucidate.

Mr. Orestes St. John supplies a report on the Wind River District Basin, and Mr. Scudder reprints with additions and alterations the report on the Tertiary Lake-basin of Florissant, Colorado, which has already appeared in the Bulletin of the Survey, and which made known the extraordinary abundance of insect remains preserved in the lacustrine deposits of that locality.

The second section of the volume is devoted to Zoology, and consists of two Reports—one of them an invaluable monograph by Mr. A. S. Packard, jun., on Phyllopod Crustacea, recent and fossil, illustrated with thirty-nine plates and a coloured map showing the zoological provinces of North America. This memoir will be welcomed by all who take interest in the investigation of genealogies and of the history of distribution in the animal kingdom. Dr. R. W. Shufeldt concludes the volume with an essay on the osteology of various American Birds, likewise copiously illustrated with woodcuts and with lithograph plates.

From this outline it will be seen how well Dr. Hayden has sustained to the last the character of the Survey under his charge. During his tenure of office he proved himself to be endowed with rare powers of organization and administration and to possess wide views of the scope of a survey which, like his, was to break ground for the first time in new and unknown territories. He might have been simply an explorer, anxious to find out the sources of rivers, the positions of passes, the heights of peaks, and the trend of mountain-ranges. He might have been a mere geologist, desirous of adding some thousand miles of new area to formations already known or of discovering formations such as have no precise parallel elsewhere. He might have been only a topographer, caring chiefly for the accuracy of his triangulations and levellings. He might have been a botanist or zoologist, eager to add new species to the known flora and fauna of the earth's surface. In one sense Dr. Hayden was none of these: in another sense he combined the functions of them all. In later years his executive duties appear to have left him little opportunity for carrying on original research himself. But he had sympathy with all the pursuits just named, and had the faculty of choosing good men for prosecuting them. He had force of character enough to succeed in battling his way and getting his appropriations from Congress, and he had the perseverance to press forward his operations, keeping his fellow-labourers together and publishing with their aid a series of volumes of which the United States may well be proud.

The consolidation of the various Surveys under one organization was an inevitable and entirely justifiable step on the part of Congress, and the United States Geological Survey could not be under more energetic and skilful direction than that of its present estimable chief, Major Powell, with the cooperation of such leaders in geological enterprise as Mr. Gilbert, Captain Dutton, and their colleagues. Nevertheless, it may be permitted to a geologist on this side of the Atlantic, who looks disinterestedly but not unsympathetically upon the progress of events on the other side, to express his regret that it should not have been possible to find a place where scope might have been afforded for the talents of one who had done such good service to geology as Dr. F. V. Hayden.

ARCH. GEIKIE

OUR BOOK SHELF

Attraction et Gravitation d'après Newton. Par Mme. Clémence Royer. Extracted from the Review "*Philosophie positive*." Pp. 23. (Paris, 1883.)

IT is very surprising to find what is, in most other respects, a really well-written and able dissertation on the question of *action at a distance* marred at the very outset by an almost inexplicable blunder.

Madame Royer has evidently read much, and lays down with great clearness the distinction between Newton's Theory of *Gravitation* as a mode of grouping together under one simple law the whole phenomena of physical astronomy, and the assumption handed down from old Greece, of a mutual *attraction* exerted upon one another by any two portions of matter. She shows that Newton everywhere expresses himself in the most explicit terms against the notion of distance-action. But she also points out the curious distinction between Newton in the *Principia*, the pure mathematician and physicist, who constructs no hypotheses and declares that the mode in which gravitation is produced is one which he has not been able to discover from the phenomena themselves; and Newton in his *Optics*, the bold speculator, who discusses the possible characteristics and properties of the medium by which gravitation may be produced.

This is, on the whole, so well done that we are positively amazed to find the all-important property of matter, *Inertia*, absolutely and entirely ignored. From a psychological point of view, the following remarks, by such a writer as Madame Royer shows herself to be, are of the very highest interest and curiosity:—

"Qu'est-ce en effet que la notion de *masse*, si ce n'est celle d'un corps déjà considéré comme pesant? Un corps sans pesanteur serait-il une masse? en aurait-il les propriétés mécaniques? Une masse, supposée absolument isolée dans l'espace, aurait-elle un poids? Evidemment non, puisque le poids ne naît que des rapports de grandeur et de distance des masses. Dire que le poids ou la masse est proportionnel à la quantité de matière ou de substance, c'est affirmer une chose que nous ne savons pas, que nous ne pouvons absolument savoir d'aucune manière. Tout ce que nous savons c'est que, considérant des corps déjà pesants, en vertu de leurs relations de quantité et de distance, leur pesanteur croît en raison de ces quantités et en raison inverse de ces distances, sans que leurs quantités, comme matière, soient altérées, de façon que des masses doubles ont une tendance deux fois plus forte à tomber l'une vers l'autre, ce qui fait qu'elles s'approchent en réalité avec la même vitesse (*sic*), et que si leur distance devient moitié moindre, elles s'approchent quatre fois plus vite l'une de l'autre.

"Mais comme l'unique moyen que nous ayons de mesurer la grandeur de ces masses est de les peser, nous restons dans l'impossibilité absolue de dire si des masses de même poids, en même relation de distance avec d'autres masses pesantes, contiennent, oui ou non, la même quantité de matière."

Evidently Madame Royer, in reading the *Principia*, has failed to notice, not only the definition of *Vis insita* but also, those important pendulum experiments by which Newton satisfied himself of the exact proportionality of weights to masses, in any one place. Here we see, in no doubtful manner, the evil effects of an education in which athletics have no part. No one, man or woman, who has had experience of Indian clubs or of dumb-bells, could for a moment doubt that we have another mode of distinguishing mass, besides weighing.

Electrotechnisches Jahrbuch von der Electrotechnischen Gesellschaft in Frankfurt am Main. (1883.)

ALL over Germany are springing up electrotechnical societies, in emulation of those in Berlin and Vienna, fulfilling a kindred part to that played in Great Britain by the much older Society of Telegraph Engineers and Electricians. The volume published by the Frankfort Society—the first of its *Proceedings*—contains several papers of interest. Amongst these may be noticed two by Dr. Th. Stein of Frankfort, on the measurement of small intervals of time by the photographic electric method; and on certain modern electro-chirurgical apparatus, especially modifications of the influence-machine of Holtz. In the first of these papers Dr. Stein describes an apparatus for photographing the pulsations of the heart, &c., as conveyed by a Marey's tambour to an apparatus which at

the same time causes a record from an automatic tuning-fork interrupter to be imprinted side by side on the photographic plate. In Dr. Stein's second paper, he describes the use of a small Deprez electromotor to drive a small fan, by which warm, dry air is caused to circulate round a Holtz machine, which by this means is always ready for action. In some historical notes by Herr Holthof, dealing with the early stages of telegraphy, there comes out the interesting point that, so early as 1854, an important improvement had been made in the suggestion of Bourseul for an electric telephone. An anonymous writer, signing himself "L." in the pages of "Didaskalia," gave in that year, under the title of "Elektrische Telephonie," an account of Bourseul's crude notion, and added something not to be found in Bourseul's suggestion, namely, the use of an electromagnet in the receiver to actuate the disk of thin metal to which the listener was to apply his ear; the description of the instrument—which, it seems, never reached anything beyond an anonymous suggestion—reads like a description of a Bell telephone, of which it is a remarkable foreshadowing. It is remarkable that Reis, who was at that time resident in Frankfort, should, when using an electromagnet in his subsequently invented telephone, have stopped short of the use of a disk in his receiver in place of the bar armature he employed. It is pretty clear he did not know of "L.'s" suggestion. The remainder of the papers in the "Year-book" deal chiefly with telegraphic and fire-alarm apparatus. The Frankfort Society is to be congratulated on the value of the papers communicated to it during its short existence.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

What are the Saccopharyngoid Fishes?

In December of last year M. Vaillant communicated to the French Academy of Sciences a notice of a remarkable deep sea fish, to which he gave the name *Eurypharynx pelecanoides*. He was in great doubt as to the relations of this form, but concluded that "of all fishes it is to *Malacosteus niger*," placed in the family Scopelidæ by zoologists, that he was most inclined to approximate the new type. Five specimens of a nearly related form, to which Mr. J. A. Ryder and myself have given the name *Gastrostomus bairdii*, were obtained by the United States Fish Commission steamer *Albatross*, in the summer and autumn of the present year. The largest of these specimens is nearly two feet long, and an anatomical investigation reveals some very remarkable peculiarities of structure, which have caused Mr. Ryder and myself to differentiate the two forms, Gastrostomus and Eurypharnyx, in a distinct order of fishes to which we have given the name Lyomeri.

The Lyomeri are fishes with five branchial arches (none modified as branchiostegal or pharyngeal) far behind the skull; an imperfectly ossified cranium, deficient especially in nasal and vomerine elements, articulating with the first vertebra by a basi-occipital condyle alone; with only two cephalic arches, both freely movable, (1) an anterior dentigerous one, the palatine, and (2) the suspensorial, consisting of the hyomandibular and quadrate bones; without opercular elements; without maxillary bones, or distinct posterior bony elements to the mandible, with the scapular arch imperfect (limited to a single cartilaginous plate) and remote from the skull; and with separately ossified but imperfect vertebræ. Whether other than the two genera mentioned, Eurypharynx and Gastrostomus, belong to this order is not entirely certain, but there is little doubt, in the opinion of Mr. Ryder and myself, that the family Saccopharyngidæ also belongs to the order, and it is for the purpose of calling attention to this doubtful and still little known type, that in behalf of Mr. Ryder and myself I address the present communication. No satisfactory information has been given as to the Saccopharyngidæ, except by Dr. Mitchill in 1824, and by Dr. Harwood in the *Philosophical Transactions* for 1827. The plate published in the volume cited represents the head of Ophiognathus with the mouth closed as well as open, and the differences in the relation of the posterior angles of the mouth to the axis indicate that Ophiognathus (as well as Saccopharynx) has a movable suspensorium, and would therefore exhibit the Lyomerous peculiarity of structure. It appears from Dr. Günther's "Catalogue of the Fishes in the British Museum" (vol. viii. p. 22), that in 1870 there were two specimens of a Saccopharyngoid fish—probably the *Ophiognathus ampullaceus*—in the British collection. (It is possible that the so-called young mentioned in the Catalogue may be a Eurypharyngoid.) The question whether that species belongs to the Lyomeri can therefore be readily settled negatively or affirmatively. Assuming that the family Saccopharyngidæ belongs to the order, the two families would apparently be distinguishable as follows:—

The Eurypharyngidæ are Lyomeri with the branchio-anal portion much shorter than the rostro-branchial; with the tail very elongated and moderately attenuated backwards; the head flat above and with a transverse rostral margin, at the outer angles of which the eyes are exposed; with the palatine jaws excessively elongated backwards and the upper parallel, and closing against each other as far as the articulation of the two suspensorial bones; with minute teeth on both jaws; the dorsal and anal fins well developed, and continued nearly to the end of the tail, and with minute narrow pectoral fins.

The Saccopharyngidæ appear to be Lyomeri with the branchio-anal portion much longer than the rostro-branchial; the tail excessively elongated and attenuated; the cranium unknown; the eyes antero-lateral; with the palatine bones moderately extended backwards (in comparison with the Eurypharyngidæ), and apparently not closable against each other; with enlarged teeth in one or both jaws; with the dorsal and anal fins feebly developed, and with pectorals small but broad. Saccopharynx is considered by Dr. Günther to consist of "deep-sea congers," but evidently it is not at all related to the congers or any other allied fishes.

I can assure English naturalists that no type of fishes will more fully reward investigation than the Saccopharyngidæ, and it is to be hoped that some master of applied anatomy, like Profs. Huxley or Lankester, may deem an examination of the specimens in the British Museum worthy of their attention. A few of the many remarkable peculiarities of organisation of the type have been described in an article "On the Anatomy and Relations of the Eurypharyngidæ," by Theodore Gill and John A. Ryder, in the *Proceedings* of the United States National Museum for 1883 (pp. 262-273), and a full monograph will appear later. May we hope for information respecting Saccopharynx in time to correlate it with that on Gastrostomus? THEO. GILL

Cosmos Club, Washington, December 18, 1883

The Mildness of the Season

As the flowering of plants at this time of the year is perhaps the best indication of the mildness of the season, I send you a list of the plants from which I and a friend gathered one or more flowers on the 24th and 26th inst. I have given the list of each day's gathering separately. Those on the 24th were gathered between this city and Hinton Charterhouse, once noted for its Carthusian monastery. Those of the 26th were gathered between Bath and Bradford-on-Avon, a very old town which contains the remains of a Saxon church and one of the finest tithe barns in England. VIATOR

Bath, December 27, 1883

List of Plants from which Flowers were gathered on December 24

Draba verna (Spring Whitlow Grass)
Primula acaulis (Primrose)
Veronica officinalis (Com. Speedwell)
Bellis perennis (Daisy)
Centaurea scabiosa (Greater Knapweed)
Ulex europæus (Com. Furze)
Achillea millefolium (Com. Yarrow)
Crepis virens (Smooth Hawk's Beard)
Lamium album (White Deadnettle)
Fragaria vesca (Wood Strawberry)

Gathered on December 26

Ranunculus repens (Creeping Crowfoot)
Cheiranthus cheiri (Com. Wallflower)

Cerastium semidecandrum (Little Mouse-Ear Chickweed)
" *triviale* (Lesser do.)
Arenaria tenuifolia (Fine leaved Sandwort)
Pimpinella saxifraga (Com. Burnet Saxifrage)
Pastinaca sativa (Wild Parsnip)
Torillis anthriscus (Upright Hedge Parsley)
Senecio vulgaris (Com. Groundsel)
" *sylvaticus* (Mountain do.)
Crepis virens (Smooth Hawk's Beard)
Hypochæris radicata (Long-rooted Cat's Ear)
Taraxacum dens-leonis (Dandelion)
Veronica hederifolia (Ivy-leaved Speedwell)
" *polita* (Gray Procumbent do.)
" *agrestis* (Green do. do.)
Lamium purpureum (Red Deadnettle)
" *album* (White do.)
Rumex crispus (Curled Dock)

River Thames—Abnormal High Tides

In a letter in NATURE of November 2, 1882 (p. 6), I gave a review of exceptional tides from 1860, and attempted to trace the causes thereof; it appeared that from 1860 to 1868 inclusive the computed maximum rise above "Trinity Standard" of high water for spring tides was 6 inches, and the actual range excess was 3 feet 6 inches above that standard.

From 1869 to 1882 the greatest computed elevation at high water was 2 feet 1 inch, and the maximum rise 5 feet above "Trinity" at Westminster, viz. on January 18, 1881, and again on October 28, 1882, the same height was attained—in each case resultant on a great north-east gale. On November 14, 1882, the afternoon tide marked 2 feet 5 inches above "Trinity," or 2 feet 4 inches above computed height—resultant again on a north-north-east gale. Since then, during the last thirteen months, there have been no very exceptional tides until last springs.

The following abstract table gives the more salient results for the present year:—

High Waters referred to "Trinity"

1883	Computed	Observed	Difference	Wind
	′ ″	′ ″	′ ″	
Jan. 22 p.m.	... 0 7 below	... 1 0 above	... 1 7	... E.N.E.
,, 24 ,,	... 0 2 above	... 1 6 below	... 1 8	... S.
Feb. 9 ,,	... 1 6 ,,	... 1 6 above	... Equal	... W.N.W.
,, 12 ,,	... 1 1 ,,	... 2 6 ,,	... 1 5	... S.S.W. to S.[2]
,, 13 ,,	... 0 1 ,,	... 2 0 ,,	... 1 11	... W.S.W.[1]
Mar. 12 a.m.	... 2 0 ,,	... 3 8 ,,	... 1 8	... N.N.W.
April 21 p.m.	... 0 6 below	... 1 0 ,,	... 1 6	... E.N.E.
June 8 ,,	... 0 5 above	... 1 6 ,,	... 1 1	... E.N.E.
Sept. 3 ,,	... 0 6 ,,	... 0 6 below	... 1 0	... W.S.W.[2]
,, 5 ,,	... 0 2 ,,	... 1 6 above	... 1 4	... N.N.W.
Oct. 1 ,,	... 0 2 ,,	... 1 6 ,,	... 1 4	... N.
,, 4 ,,	... 0 1 ,,	... 2 0 ,,	... 1 11	... N.N.W.[2]
,, 16 ,,	... 1 2 ,,	... "Trinity"	... 1 2	... W.S.W.[2]
Nov. 5 ,,	... 1 1 below	... "Trinity"	... 1 1	... W.N.W.
,, 6 ,,	... 1 9 ,,	... 0 6 below	... 1 3	... W.[2]
,, 19 ,,	... 0 1 ,,	... 1 6 above	... 1 7	... W.
,, 29 ,,	... 0 8 ,,	... 0 8 ,,	... 1 4	... S.S.E.
,, 30 ,,	... 0 5 ,,	... 1 0 ,,	... 1 5	... W.
Dec. 1 ,,	... 0 3 ,,	... 1 9 ,,	... 2 0	... N.N.W.
,, 12 midnight	0 5 ,,	... 3 6 ,,	... 3 11	... W.N.W.[2]
,, 16 a.m.	... 1 1 above	... 3 8 ,,	... 2 7	... N.[2]

[1] A gale. [2] A great gale.

It will be observed that in the majority of cases northerly winds accompany or have preceded the exceptionally high tides; also how a great westerly gale blowing down the river depresses the range of tide. The most remarkable result is that attendant on the great gale of the 12th inst. during last springs, for although high water level was less by 18 inches than in January, 1881, and October, 1882, it was exceptional for its great rise over the computed elevation, being no less than 3 feet 11 inches above the height denoted in the Admiralty tide tables with the reservation before named in my former letter, that the computed heights are for London Bridge. The high water of October 28, 1882, was 3 feet 4 inches above computed height; but the very remarkable tide of January 18, 1881, was actually 5 feet above the estimated range, which was only level with "Trinity Standard." The afternoon tide of Sunday, the 16th inst., was also, it will be seen, very much increased by the northerly gale then prevailing. J. B. REDMAN

6, Queen Anne's Gate, S.W., December 19, 1883

Deafness in White Cats

REFERRING to the note in your issue of December 13 (p. 164), by Mr. Lawson Tait, on "Deafness in White Cats," I should like to state, if my remarks may not be out of date, that my father kept a breed of deaf white cats over several years; and on making an inquiry regarding these cats of my brother, who now lives in Reading, but who at that time was resident with my father on a farm in North Hampshire, he informs me that the deaf cats were all white with blue eyes, with one single exception, and that one refers to an aged mother who was named "Deaf," on account of her infirmity, and who had eyes of different colours, the one being "red," or pink, as seen in white rabbits, and the other blue. So remarkable was the appearance of this cat that the eyes often attracted the attention of visitors, and my brother has more than once related to me a circumstance which I should not mention here, save that it so thoroughly bears on this question as one of fact. On one occasion a neighbour, remarking on the ocular peculiarities of this cat, elicited from my father the jocular reply that "she had one eye for the rats, and another for the mice." My brother further states that these deaf cats were all females, and that the breed was preserved on account of its furnishing "good mousers." I apprehend that this characteristic may in some measure be attributed to the character of the eyes enabling the animals to see better in obscure light. Males were not preserved, because they became rovers and destroyed the game. When any of the offspring were pied, or otherwise coloured, they were not deaf. Bearing on this, and evidently referable to my brother's early associations, he once observed, in his walks round Reading, a white cat with blue eyes sitting at a cottage door, and on inquiring he found that the animal was deaf; but he made no observation as to whether it was male or female. JOSEPH STEVENS

Oxford Road, Reading, December 24, 1883

Teaching Animals to Converse

I HAVE read with interest Sir John Lubbock's communication (p. 216), but I would like to know whether any precautions were taken to find out whether "Van" selected the right card by his sense of sight or by scent? This could have been easily done by changing the card for a facsimile which had not been previously scented. A more thorough test would be to employ a set of cards with "Food" written on one side of each and some other word on the other, then putting the cards in cases with an opening exposing one word only. The cards could then be put in a row and be kept in the same relative position, the changes for the experiments being made by turning the cards in their cases. Would it not be simpler to commence with drawings on the cards instead of words. For instance, a saucer or biscuit for "Food," a bone for "Bone," a hat for "Out," &c.?

Hanover, January 5 J. S. B.

On the Absence of Earthworms from the Prairies of the Canadian North-West

AN incidental allusion is made by Mr. Christy in NATURE of the 3rd inst. (p. 213) to Darwin's statement that earthworms "abound in Iceland." In 1881 I spent several weeks in that island, and had occasion many times to search for worms as a bait for trout and char around Thingvalla, Ori, the Sog River, &c., and could not obtain them except near the farmhouses—which are at great distances from each other—and absent altogether from the interior of Iceland, which is uninhabited and a desert. RICHARD M. BARRINGTON

Fassaroe, Bray, Co. Wicklow, January 4

Merrifield's "Treatise on Navigation"

I BEG to thank your reviewer of my book for the suggestions he has made in NATURE of December 20 (p. 169), and should like to point out to him that he must have overlooked some remarks contained therein, when he says:—

"We regret that Mr. Merrifield has omitted from the chapter on Traverse Sailing the warning given by Raper, that, especially in high latitudes, the difference of longitude should be found on each course," &c., by Mercator's sailing.

Will you kindly allow me to remark that I mention this twice in my book? First, on pp. 88, 89 I say, "Middle-latitude sailing should not be used in (*a*) high latitudes; (*b*) when the difference

of latitude is great; and (*c*) when the two places under consideration are on different sides of the Equator. In these cases Mercator's sailing should be used." And again, on p. 104, when speaking of a ship's journal (which I considered the right place to introduce it), I give this caution :—

"As longitude by inspection depends on the middle latitude, the cases in which it should not be used as explained under middle-latitude sailing should be attended to: and if the latitude be high, or the distance made good be great on a small course, then correct longitude can only be obtained by finding the position of the ship by Mercator's sailing on every change of course."

JOHN MERRIFIELD

Navigation School, Plymouth, December 22, 1883

[I WAS, of course, aware of the existence of the paragraphs mentioned by Mr. Merrifield, but they do not seem to meet the point raised, viz. that no notice was taken in the chapter on Traverse Sailing of the necessity of finding the difference of longitude on each course in high latitudes, although the subject is incidentally referred to at p. 104. There will doubtless always be differences of opinion between the writer and reviewer of a book, but it seems to me that, in teaching, the theory should be unassailable. Whether in practice it is necessary to apply all the corrections required should be left to the judgment of the practitioner. Mr. Merrifield has reversed this order, having omitted certain rules from the instructions on Traverse Sailing, but mentioned them casually in a paragraph preceding the copy of the log.—THE REVIEWER.]

AN AMERICAN ROTHAMSTED

HALF a century has elapsed since Sir John Lawes commenced at Rothamsted Park, in Hertfordshire, the unique series of experiments the results of which have produced so salutary an effect on agricultural practice. The inquiries were at the outset restricted to determining the influences of various kinds of manures, and these led to the institution, in the year 1843, of systematic field experiments which are still in progress. Wheat and barley have been grown on the same land for forty-one consecutive years, oats for twelve years, turnips for thirty years, potatoes for nine years, meadow herbage for twenty-eight years, while beans, clover, sugar-beets, and mangel-wurzel have likewise been grown more or less continuously, and all under the varied influences of the different manurial agents. The influence of soils and manures on the composition of crops, the relations of botanical characteristics to the soil and to manures, the physical and chemical properties of the soils themselves, the transpiration of water by plants, the question as to whether plants assimilate free nitrogen, the composition of rain and drainage waters,—these are some of the chief problems which have been the subjects of research. Not less noteworthy are the experiments which have been made with animals, such as the determination of the relation of quantity and kind of food consumed to increase in live weight, the proportion and relative development of the different organs of farm animals, the composition of the animals in different conditions as to age and fatness, the composition of the solid and liquid excreta in relation to that of the food consumed, and the composition of the ash of animals in different conditions and variously fed.

Valuable and highly appreciated as are the many published results of the Rothamsted researches, yet their significance could not fail to be greatly enhanced were it possible to compare them with similar experiments carried on elsewhere. But the efficient equipment of an agricultural experiment station like that at Rothamsted is a very costly affair, and, unless State aid can be relied upon, it can hardly be undertaken save through the munificence of private individuals. The splendid example set by the founder of the Rothamsted station in this country has stimulated an American gentleman to establish in the State of New York an experimental farm which is already well on the way towards becoming another Rothamsted. The credit of this enterprise is due to Mr. Lawson Valentine, who thereby realises "a long-cherished plan for doing something towards the progress of American agriculture," and at the same time providing a pleasant country home conveniently near his place of business in New York City.

Houghton Farm, Orange County, is within two hours' railway journey of New York City, and occupies an area of 600 acres. In the summer of 1879 the proprietor secured the services of Dr. Manly Miles as director of the projected experiments, and after a period of eighteen months, during which the fields were laid out and drained, the experiments were begun. Since the summer of 1881 the experimental work has been carried on as a distinct department, quite separate from that of the farm proper on the one hand, and from that of the residential portion of the estate on the other. Thus the present plans as to Houghton Farm are, in the words of the proprietor, the following :—1. That the farming operations be carried on in accordance with the best known methods, and under the best possible organisation and management, with a view to educating and enlightening others by furnishing valuable examples and results in practical agriculture. 2. That there be a scientific department devoted to agricultural investigation and experiment, and that such department be of the highest order, so as to command the respect, interest, and co operation of the leading scientific minds of this and other countries. 3. That Houghton Farm be a comfortable, healthful, and attractive home for the family of its proprietor, and afford large hospitality for friends and guests.

Two distinct though closely related and parallel lines of investigation are recognised. Firstly, the purely scientific work of the laboratory to gain a knowledge of the elements of animal and vegetable nutrition, and of their relations under known definite conditions. Secondly, accurate and well planned experiments in the feeding of animals and in the growth of crops to answer the various practical questions that arise in the management of the farm, and to determine the agricultural value of the facts and theories that are presented as the result of purely scientific investigations. Experiments under this second head demand, on the part of those who conduct them, an extended knowledge of practical farming, as well as the trained skill and ability for original investigations that are required in researches in pure science.

As the system of growing the same kind of crop on the same land for a continuous series of years, in the manner followed at Rothamsted, appears to be the only one that can be relied upon to give consistent and trustworthy results, this method has been adopted at Houghton Farm. But besides wheat, barley, and oats, the staple American cereal, Indian corn, forms the subject of a special series of experiments. Indian corn is successfully cultivated over a very wide area; it much exceeds in aggregate value any other crop grown in the United States; it is of great importance as a cleaning crop; and the large amount of cattle food of good quality it is capable of yielding, together with the value of the manure produced per acre when it is fed on the farm, all point to this crop as the one a series of systematic experiments upon the cultivation of which will yield results of greater practical interest to American farmers than will experiments with any other field crop.

The first report on the experiments with Indian corn has already been published, with considerable elaboration of detail. Some interesting results have been established, particularly those on the influence of drainage, on the employment of barnyard manure, and on the character and quality of the grain.

Prof. D. P. Penhallow, the botanist and chemist at the station, has issued no less than four reports last year and this. These deal respectively with the meteorology of the district in which the farm is situated, based

on observations extending over a period of six consecutive months; with soil temperatures, a series of observations embracing a similar period; with the normal condition of vegetable structure with reference to cell contents; and with "peach yellows," a disease attacking peach trees. To do justice to any one of these memoirs would really require a separate notice, but the mere mention of them will serve to indicate some of the channels into which the energies of this new centre of research are being directed. In connection with the meteorological work, however, it is worth noting that daily bulletins were issued, the predictions being made for twenty-four hours from noon to noon. The whole number of predictions made was 210, of which only 1·9 per cent. proved incorrect, so that the bulletins came to be depended upon and served a most important purpose for the time during which they were issued. All the reports are printed in an attractive form, and special pains appear to have been bestowed upon the diagrams and coloured plates.

To the names that have already been mentioned it is necessary to add that of Mr. Henry E. Alvord, who has undertaken the duties of general manager. Mr. Alvord's name is already familiar to agriculturists on this side of the Atlantic, particularly in connection with American dairy farming, and his association with Houghton Farm is another guarantee, if one were needed, of the thoroughly business-like manner in which the new experiment station is to be conducted.

From this brief sketch it will be seen that there exist at Houghton Farm potentialities whose development can hardly fail to exercise considerable influence on the agricultural practice of the future. Those who have studied the Rothamsted results will be glad to compare with them the results deduced from the Houghton Farm experiments, and each station will be benefited by comparing notes with its friendly rival, while the valuable work which English agriculturists associate with the names of Lawes, Gilbert, Pugh, Masters, and Warington will, it is to be hoped, find a parallel in the discoveries we shall confidently look for from the transatlantic station. Intentionally planned, in many details, upon the same lines as Rothamsted, there is one point in which the new station specially resembles its English prototype, and it is contained in the words, "Visitors are always welcome at Houghton Farm." W. FREAM

EDELMANN'S ELECTROMETER

AMONGST the many forms of electrometer that derive their origin from the quadrant electrometer of Sir William Thomson is that of Edelmann, which is very extensively used in the physical laboratories of the Continent. Dr. Edelmann, whose name it bears, is not only proprietor of workshops in Munich, which are rapidly winning renown for the excellence of the instruments which they turn out, but also holds the post of *privat-docent* in the Polytechnicum of Munich.

In the parent instrument of Sir W. Thomson, and in most of the modifications of that instrument which go by the names of Branly, Kirchoff, Mascart, &c, the quadrants are literally four quadrants cut from one plane circle; and in most of these instruments the *needle* is of the flat dumb-bell or lemniscate form which Sir W. Thomson himself gave to it. Dr. Edelmann has, however, taken a departure in quite another line, his instrument being very appropriately named the "cylinder-quadrant" electrometer. The three accompanying figures show the essential parts of the instrument. The quadrants, marked G in Fig. 1, and *a*, *b*, *c*, *d* in Fig. 2, are formed by taking a metal tube, furnished with flanges above and below, and slitting it into four parts by four equidistant cuts parallel to the axis of the tube; the four pieces being then set in their proper places by being screwed to two rings, R and S, of ebonite. This arrangement has some advantages over those of the ordinary quadrant electrometers. In these, when the quadrants consist of four pieces of flat brass borne each on an insulating pillar, it is difficult to set them so that they shall be all exactly in one plane; and when, as in some of the more delicate instruments, the quadrants are made of a hollow box slit into four parts, there is found the further difficulty of arranging the quadrants so that the needle can be taken out and replaced. These difficulties are, to a large extent, obviated in Dr. Edelmann's form of instrument; for the inner surface of the cylinder, which constitutes the four quadrants, can be turned perfectly true after the quadrants have been screwed to the ebonite rings; and there is no difficulty at all in lowering the needle into the cylindrical cavity within the quadrants, or in lifting it out. The needle itself is of the form shown in Figs. 2 and 3, and

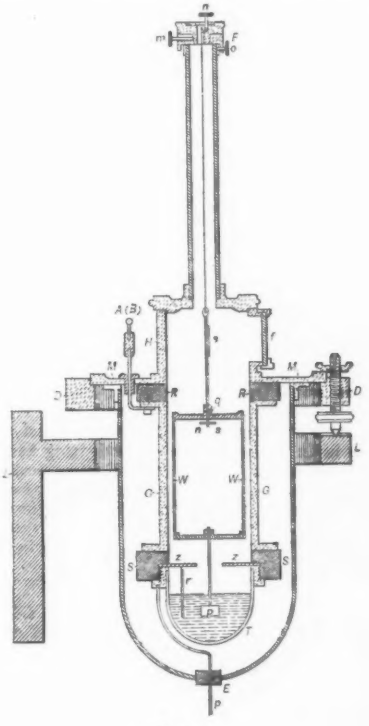

FIG. 1.

consists of two portions of metal (W W) cut from a cylinder, united above and below, and hung by a single fibre of small torsion from an adjustable head, F, above. A mirror, *s*, is attached above the needle, and a platinum vane, P, below it dips into a vessel, T, containing sulphuric acid. To give directive force to the "needle" a small magnetic needle, *n s*, is attached to it. This device was indeed used in some of Sir W. Thomson's early instruments, though subsequently abandoned in favour of the bifilar suspension usually adopted. It is of course understood that the opposite pairs of quadrants are, as usual, connected together. Electrodes, A, B, pass through the metal plate, M, which covers the instrument, and are connected with the quadrants as shown in Fig. 1. An outer jar of glass surrounds the instrument and is fixed to the under side of the plate M by a bayonet point. The plate M itself is very substantial, and is provided with three levelling screws which rest in V-grooves in a strong ring-

shaped support of cast zinc, L L, which is screwed to the laboratory wall like a bracket.

It will be seen that Dr. Edelmann has discarded the Leyden jar, replenisher, and gauge, which play so important a part in Sir W. Thomson's electrometers. Instead of these a Zamboni pile, or a battery of 200 small well insulated voltaic elements, is used. These are made of test-tubes filled with common water, and having small zinc-copper pairs placed from cell to cell. It is difficult to believe that either of these dispositions is an improvement on the replenisher-jar-gauge arrangement, though either may be somewhat cheaper. Nor is it likely that the presence of the ebonite rings R and S will add, in the

FIG. 2.

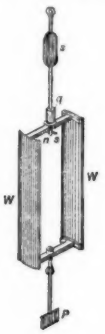

FIG. 3.

long run, to the satisfactory working of the instrument; for, as is well known, this substance when exposed to light decomposes at the surface, and becomes covered with a conducting-film of acid. The insulation of the quadrants ought not to be risked by such a doubtful device. It ought to be mentioned that a cylindrical arrangement of quadrants had been previously employed by Silow in an instrument for investigating the dielectric capacity of liquids: but to Dr. Edelmann is due the credit of having applied this arrangement for the construction of these electrometers, which in consequence of their many good points are becoming so popular for laboratory work both in Germany and elsewhere.

GLEANINGS FROM THE REPORTS CONCERNING THE ERUPTION OF KRAKATOA

I DO not propose to give here an abstract of all the reports which I have gathered, but I only wish to state some important data which might be useful to those who wish to become acquainted with the full particulars concerning the eruption. Therefore I have mentioned the authorities from which I have taken the following statements, in order that the reader who wishes for more circumstantial reports may find them easily.

I regret to say that I have not been able to find any reports from Tjiringin and the lighthouse-keepers of Java's First Point and Vlakke Hoek. In the beginning of October an engineer of the mine-service was sent to Krakatoa to examine the island, and he is expected now to bring in a scientific report about the eruption; it is to be hoped he has insisted that everything referring to the catastrophe should be circumstantially recorded.

1. *Data referring to the time anterior to the Eruption.*—In a report which was published in the *Java Courant* (the paper of the Dutch Government), which was brought from Batavia by the mail of August 25, it was said: "There are now two craters on Krakatoa, 3 km. distant from each other, which are continually working. The western crater is at the foot of Mount Perbuatan (working since May 20); the eastern crater working since a more recent date (which is unknown to me) at the foot of Mount Dannan. The outlines of the top of Mount Perbuatan are changed; the outlines of the beach are also altered by some increase of land along the shore. The trees which covered the island are burnt for the greater part."

As to what occurred before and during the eruption of August 26 and 27 I particularly took the data:—

(1) From the report of the *Berbice*, Capt. Logan, from New York (*Nieuws van den Dag*, October 11): August 26 at 2 p.m. she was off Vlakke Hoek, 20 miles to the south; she got sight of the light of Java's First Point August 28 at 12 p.m. Since August 26 at 4 p.m. she had only little sail; 28, at 4 a.m., maintopsail was set; afterwards at noon she set full sail and made for First Point. Therefore she was during the eruption near a line which joins Java Head and the point where she was August 26 at 2 p.m.

(2) From the report of the *Charles Bal* (NATURE, Dec. 6, p. 140): She passed Prince's Island August 26, at 9 a.m.; Krakatoa seen at 4.15 p.m., north half east, 10 miles distant. At 11 p.m. the island became more visible, west-north-west, 11 miles distant; August 27 at 6 a.m. she set sail, passed lighthouse Fourth Point at 8 o'clock, Anjer at 8.30; passed Button Island at 10.15.

(3) From the report of eye-witnesses, who were at Anjer during the catastrophe (*Nieuws van den Dag*, October 11 and 14).

(4) From a report written by a passenger (an engineer) of the *Gouverneur Loudon* (Dutch Indian steamer, 761 reg. tons, 190 h.p.) (*Nieuw. Rotterdam. Court.*, October 23, by Mr. van Sandick): She was off Anjer August 26 at 3 p.m.; went to Telok Betong, where she arrived at 7 p.m.; remained there till next morning at 7 o'clock. After a wave had destroyed Telok Betong she made for Anjer, but before she had left the bay darkness came on, and she was compelled to lie there till August 28 in the morning.

(5) From the report of eye-witnesses at Telok Betong (*Nieuws van den Dag*, November 3 and 13).

Moreover, I took a few particulars from the reports of Katimbang (*Nieuws van den Dag*, October 16) (Lampongs, at the foot of the Radjah Bassa), Binuangan (*Nieuw. Rotterdam. Court.*, October 23) (at the bottom of the Semangka Bay), and Pulu Merak (*Nieuws van den Dag*, October 10).

Though *e.g.* on the Island Bali strong detonations were heard in the morning of August 26, the reports of Telok Betong and Anjer say: Fine weather, no extraordinary detonations in the afternoon. *Berbice* reports: Sky dark at 2 o'clock, threatening at 4 o'clock; at 6 p.m. thunder and lightning. On board the *Charles Bal* at 4.15 an eruption at the east of Krakatoa was observed; the masses which were driven forth to the east had the appearance of a furious squall. Anjer reported: At 6 o'clock quite dark; at Telok Betong at 6 p.m. slight rain of ashes; at the same time *Berbice* experienced ashes pouring down at once; it was quite dark. Fall of ashes and darkness continued the whole evening. About this time the commotion of the sea began also. At Anjer, between 6 and 7 p.m., several vessels were carried by the wave to and fro in the harbour (canal), but the sea did not flow over. From Merak is reported, August 26, at 7 p.m. or 7.30 p.m.: Heavy detonations, violent shocks (but no earthquake). Waves swept away the Chinese camp; caused much damage. In the night (I could not find out at what o'clock) fiery phenomena were seen in the direction of Krakatoa, shocks of earthquake, waves. The Controleur, who was at Katimbang, related: "August 26, 7 p.m., several prows thrown on the beach, waves, but the sea did not flow over, nor did the waves grow higher."

The *Loudon* came to anchor off Telok Betong at 7 p.m. Rough sea, boats could not communicate. They observed that there was something wrong, but could not make out what it was. The Dutch bark *Marie*, which was there

also (there are two vessels of the same name, *Marie* and *Maria*, in the list, the one, *Marie*, of 570, the other, *Maria*, of 790 tons) reported: At 7.30 currents observed in different directions, some small vessels lost their anchors, ten persons saved from being drowned. From Telok Betong is reported: By 6.30 sea quite calm, level of the sea 1 metre lower than pier, a moment afterwards 1 metre above it; people who were at the end of the pier, about 1000 metres distant from the shore, had to walk back through the water, which was done without accidents. Meanwhile the *Charles Bal* was in a fearful situation since 5 o'clock. She reports:—"At 5 p.m. sky darkening, detonations stronger, pumice-stones pouring down, rather big pieces, had to cover skylights. At 6 p.m. big pieces ceased, small pieces, ashes, &c., continued. Terrible night. After 7 p.m., at Anjer, heavy detonations were heard, the ground was groaning, thunderstorm; by 9.30 calm, slight rain of ashes. After this the sea was very calm. After midnight some waves were observed, which were not violent. Lloyd's agent at Batavia wrote under date of October 16 (*Scotsman*, November 24):—"But we know now that the village of Sirah, six miles below Anjer, was partially submerged at 1 o'clock on Sunday night, August 26. This I had from the head man himself, who at the time reported it at once. . . . At Anjer, however, nothing was felt and no alarm was experienced." At Katimbang a noise was heard of a far-off wave at 10 o'clock, and the Europeans and natives went to a higher place. During the night the waves were heard causing an awful devastation. At Telok Betong, by 10 o'clock, several vessels were thrown on the beach (among which the steamer *Berouw*, draft 1·75 m., 4 guns, 30 h.p., 4 Europeans, 24 natives), houses swept away, people drowned, &c.; towards midnight calm.

From this it seems to me that no extraordinary detonations were heard nor any phenomena seen which could have startled the inhabitants, who, however, had been accustomed for three months to the noise of Krakatoa.

Meanwhile the outburst continued. The *Berbice* reported:—At midnight ashes increased, pieces of pumice-stones, thunder and lightning increased, fireballs fell on deck and were scattered about, fearful roaring, copper at the helm got hot; helmsman, captain, and several sailors were struck by electric discharges; sail over the hatches to prevent fire, helm tied, crew sent below, captain and master kept guard; 27th, at 2 a.m., all hands to shovel ashes into the sea (were about 3 feet thick lying on deck). In a still worse situation was the *Charles Bal*. Lightning continued; saw a light at 11 p.m., supposed it to be the light of the Fourth Point (Anjer lighthouse); lay by; Krakatoa visible in west-north-west, 11 miles distant; wind strong south-west, chains of fire appearing to descend and ascend between the sky and the island, while on the south-west end there seemed to be a continued roll of balls of white fire; the wind, though strong, was hot and choking, sulphurous, with a smell as of burning cinders, some of the pieces falling on us being like iron cinders, and the lead from a bottom of 30 fathoms came up quite warm. From midnight to 4 a.m. (27th) wind strong, but very unsteady between south-south-west and west-south-west, impenetrable darkness continuing, the roaring of Krakatoa less continuous, but more explosive in sound, the sky one second intense blackness, and the next a blaze of fire; masthead and yardarms studded with corposants, and a peculiarly pinkish flame coming from the clouds, which seemed to touch the mastheads and yardarms."

On the morning of August 27, by 6 o'clock, as is reported from Binuangan (Semangka Bay), the sunken cliffs were visible; a little while afterwards a wave came and returned, but another followed, which did much damage; soon (?) after this it became quite dark, mud and ashes poured down; several waves followed till late in the evening; darkness continued till next morning.

From Anjer is reported that it was about 6 o'clock when the first wave came. One of the persons who were saved said: "I went out about 5.15. After having talked with several persons, I saw the wave, still far off, rapidly making way towards us. I ran away, was followed by the wave, fell down quite exhausted, but happily on a hill, where the water could not reach me. Before my eyes all the houses along the beach were destroyed." Another person reported:—"I was early at the beach (early, after Indian habit, might be at 5 o'clock). When I returned home I heard a cry, 'The flood comes.' On looking round I saw a high wave which I could not escape; I was lifted from the ground, but caught hold of a tree. Then I perceived several waves, which followed the first; the place where Anjer had been before was covered by a turbulent sea, from which some trees and roofs of houses were still peeping out. After the wave had flowed off, I left the tree, and found myself in the midst of the devastation. The Chinese camp was not yet destroyed." A third person, who was still in bed at 6 o'clock, was lifted up by the wave and carried to a hill. All agree that after 9 a.m. it became dark, and a pouring down of mud and ashes commenced (darkness till next morning), &c. From Merak it is reported that in the morning all European officers were in their houses; when the first wave came they were not afraid, and would not yet go to the hills. The *Berbice* reported: "Till 8 o'clock it was, as before, quite dark, afterwards worse." The *Charles Bal*: "August 27, 6 a.m., being able to make out the Java shore, set sail. Passing Fourth Point Lighthouse at 8, hoisted our signal letters, but got no answer. Passed Anjer at 8.30, name still hoisted, close enough in to make out the houses, but could see no movement of any kind; in fact through the whole straits we have not seen a single moving thing of any kind on sea or land."

I must confess I am here at a loss. It is possible that the *Charles Bal* passed Anjer after the first wave had annihilated most of the living beings and before the following waves had finished the destruction of buildings, though it would be strange if at the lighthouse all the people had been killed before the building was destroyed. Moreover, it seems strange to me that the captain should not have seen the devastation nor remarked the tidal waves When they came on, the ship was very near them, and even if we suppose that the waves had been shot like a projectile from Krakatoa on to Anjer, it would be astonishing that such a considerable mass of water should not at all have been perceived, or not described if it had been. We learn from Anjer (and from Telok Betong) that it was seen from the beach like a black wall, and it must have had a considerable height, for it covered all the houses and trees which were near the beach; now an ordinary house might at least be ten or twelve metres high, and the shaft of a cocoanut tree has also a considerable length. *Loudon* reports: August 27, in the morning fine weather, at 7 a.m. an immense wave came on; the *Loudon*, under steam, turned her head to it, was lifted up, but kept well; now the wave rushed on to the beach, and before the eyes of the passengers and crew of the *Loudon*, houses disappeared; the *Berouw* (which had been thrown on the beach on the evening of the 26th) was lifted up and carried a few kilometres into the land. The place where Telok Betong had been before was changed into a violent sea (except the buildings on the hills). Three other waves followed at short intervals. Since it was supposed that the cable had been destroyed, the steamer intended to go to Anjer to report the catastrophe. Before she could get out of the Lampong Bay it darkened. The mate of the *Marie* reports: August 27, in the morning the sea was calmer, but queer weather, sky threatening, prepared the third anchor. At once we saw an immense wave at the horizon making rapidly its way on to us; we spiked up the hatches, and after having done it the first wave struck

the vessel, and threw it on the beach; after the wave had flowed off, the *Marie* was literally on dry sand; one could have walked around the vessel. Part of the crew left the ship. From the barracks at Telok Betong, on the Talang Hill, about twenty-five metres above the level of the sea, an eye-witness wrote: At 6.20 I went to Kampong (village) Kankong, about 1400 metres distant from the barracks, to see the destruction which the wave had caused the night before. After I was there I saw a wave rushing on to us; we hastened to the hills, the villagers following us. When I had reached the barracks, I saw Kampong Kankong had disappeared, and so had the other villages near the beach. Before the darkness began the water rose. At Katimbang they perceived in the morning what damage had been done—by little and little it became dark.

At 10 o'clock it was so dark aboard the *Loudon* that not even outlines of the ship or persons were visible; she stopped for eighteen hours. Rain of mud covered the deck 0·50 metre thick. Needle of the compass violently agitated; barometer extremely high; breathing difficult through damp; some people got unwell and sleepy. After the darkness began the sea became violent, the wind increased; at last it was a hurricane. Then several heavy seas came, some of which came across and almost capsized the vessel. The flash of lightning struck the *Loudon* seven times, went along the conductor, but, when still above the deck, sprang over into the sea. This was accompanied by a dreadful crackling. At such moments the vessel and the surroundings were brightly lighted; it was a fearful sight, everything being covered with a grayish mud. During all this time the *Loudon* was under steam, steaming slowly at two anchors. St. Elmo's fires at the masts and yards. August 28, at 4 a.m., feeble moonlight (moon's rise at Batavia, August 28, at 2.15 a.m.) at the horizon. After the sun had come up she tried to leave the bay. It seems worth attention that during all these fearful hours no detonations were heard aboard the *Loudon* (this is expressly mentioned in the report).

At Merak an immense wave came by 9 o'clock from the west and rushed to the east. The European who alone escaped went to the hills, while darkness surrounded him. The mate of the *Marie* writes:—By 10 a.m. (August 27) three heavy seas came after each other; quite dark; at once a fearful detonation. Sky in fire, damp. By 3 p.m. three seas again, after this the sea quite calm. Dark till next morning, then (28th) *Marie* was found afloat again. From the barracks (Telok Betong) it is reported:—By 9.30 a.m. a downpour of ashes, later stones and mud; about half an hour afterwards the level of the water was only 1 or 2 metres below the top of the hill. Now it was taken into consideration to give up the barracks and retire to a higher point. In the night the rain of mud ceased by little and little, the sky cleared up, stars appeared. When, at Katimbang, it had become quite dark, fearful detonations, like thunder and reports of guns, were heard. By 11.30 pouring down of stones began (the biggest as large as a fist). Half an hour after, 12 o'clock, it became quite dark; heavy rain of ashes soon afterwards, hot ashes (during a quarter of an hour), then cold ashes; darkness continued (it is not said when it dawned). From the *Charles Bal* is reported: "At 11.15 there was a dreadful explosion in the direction of Krakatoa, now over thirty miles distant. We saw a wave rush right on to the Button Island, apparently sweeping right over the south part, and rising half way up to the north and east sides. This we saw repeated twice, but the helmsman says he saw it once before. The same wave seemed also to run right on to the Java shore. At the same time the sky rapidly covered in, the wind strong from south-west by south; by 11.30 we were inclosed in a darkness that might almost be felt, and at the same time commenced a downpour of mud and sand, &c., which put out the side lights. At noon the darkness was so intense that we had to grope our way about the decks, and although speaking to each other on the poop, yet could not see each other. This horrible state and downpour continued till 1.30, the roarings of the volcano and lightnings being something fearful. By 2 p.m. we could see some of the yards aloft, and the fall of mud ceased. (Here the explosion and the beginning of the darkness are reported about two hours later than from Lampong Bay or from Anjer, and still more astonishing is it that nothing is said about the wave which annihilated Merak). At 5 p.m. the sky cleared up in the north-east, but till midnight sky dark, now and then ashes falling. Though the vessel was sixty-five to seventy miles distant from Krakatoa, the roaring of the volcano was still audible." From the *Berbice* is reported: At 11 a.m. (27th) strong wind south-east; at 3 p.m. high wave (about 20 feet high) struck the vessel so hard that the chronometers were arrested. Thunder, &c., continued, and the hands of the barometers were violently agitated between 28 and 30 inches. At 6 p.m. no change, sea relatively calm, lightning allowed us to see the vessel surrounded by a sea of pumice-stone; at midnight, weather calm, lightning more remote. August 28, at 4 a.m., calm, maintopsail set. Darkness continued. At 8 a.m. they saw daylight again. Weather calm and bright. Ship covered with ashes about 8 inches thick. During the eruption about 40 tons of ashes were thrown overboard; more sail set; had full sail at 12 o'clock, and went straight on to Java Head. Floating pumice-stone diminished the speed of the vessel. At midnight light of First Point was seen; when they passed Prince's Island they saw banks of pumice-stone 18 to 24 inches thick. In the afternoon they passed between Krakatoa and the Java shore. As far as they could see the island was by two gaps divided into three parts. The sea was covered with pumice-stones and floating corpses.

I continue the report of the *Loudon*:—Ashes and pumice-stone were still falling, but only slightly; the vessel was near the shore; it was a dreadful sight, trees buried under ashes and mud, the sea covered with pumice-stone and driftwood. Near Pulutiga the entrance of the bay was obstructed by islands of pumice-stone, like cliffs; they formed a bridge between Pulutiga, Sebuku, and the mainland. Since the channel of Lagundi Straits seemed comparatively open, the *Loudon* made for it, but she met there with an island of pumice-stone, about 3 m. thick; she went ahead against it, the pumice-stone gave way, and though there were some difficulties at the pumps, the *Loudon* got free; now it was resolved to go to Anjer, the vessel came to the Sunda Straits, west (in the report is said east, which seems a slip to me), then south of Krakatoa; when this island was at larboard (I think it means when the *Loudon* went to the north, passing between Krakatoa and the Java shore, for after having left the Lagundi Straits, she continually had Krakatoa on the larboard) it was seen that the greater part of the island had disappeared; there was a steep crater-wall, the peak as it were cut into two. In the wall large cracks filled with smoke were remarked. In the sea between Krakatoa and Sibessie several volcanic reefs were seen, there, as it seemed, volcanic powers were still at work. At eight different places columns arose, which, after having originated in a dark point, grew larger, got as it were a white bordering, arose to a considerable height, and gave way to another column. It could not be made out whether these phenomena were waterspouts or volcanic eruptions.

It is known that the detonations were heard all over the Dutch colonies and further; I only beg to record that at Acheen, 5½° N. lat., they were so distinctly heard that military forces were sent out, since it was supposed that a fort had been attacked. It may be interesting to see a report from Padang Panjang, which runs as follows: August 27, 8.30 a.m., at once a heavy explosion, a single

thick cloud of smoke arose (from Mount Merapi 6° 20' S. lat., 100° 28' E. long. Greenwich) drove directly away; now smoke arose from a point at some distance from the crater, uncertain whether it originated in ejected matters, or whether there were fumaroles. After five minutes the same phenomena were observed; afterwards it was perfectly quiet. At 10.50 a.m. hollow groaning; another column of smoke arose; ashes falling eastward; two columns of smoke. During all this time a fearful noise was heard from afar, which became stronger after 11 a.m.

Dr. B. Hagen wrote to the editor of the *Ausland* (*Ausland*, No. 46) from Tandjong Morawa (Deli, Sumatra, almost 1000 km. distant from Krakatoa): In the afternoon (27th) thick white clouds were seen coming from the volcano Sipaiak (or Guming Balerang), more than 30 km. distant to south-west.

From Menggala (130 km. from Telok Betong to the north-west) is reported: Slight concussion of the air, rain of ashes, darkness. From Sukadana (105 km. from Telok Betong to the north-east) is reported: Much damage done by falling ashes and stones.

During the eruption there were still two vessels near the Sunda Straits the reports of which are to be mentioned. The *Annesley* (*Times*, weekly edition, Oct. 12), Capt. Strachan, from Singapore, August 27, for Mauritius: At 10 a.m. it was so dark that they had to light all the lights. Barometer rising and falling ⅓ inch to 1 inch in the minute. Ashes and pumice-stones falling. Towards the night ashes stopped, but it was as black as night. August 28, they passed the Sunda Straits, and heard from the lighthouse-keeper (Java's First Point) that he had had fearful weather. Had some of the ashes as far as 100 miles clear of Java Head.

The hopper-barge *Tegal* made from Batavia for Merak, August 27, early in the morning. On the way they met with ashes and stones pouring down; it became quite dark, sea rough; came to anchor by 12 o'clock; dreadful weather; she dragged her anchor. Towards 3 o'clock the sky cleared up, then went on till 5 p.m. In the night they saw a bright light in the south and west, many flashes of lightning, and balls of fire; several sea-quakes; at once sea like glass. In the morning (August 28), when it dawned, the *Tegal* was off St. Nicholas Point; now she entered the straits; they saw the devastation. At Dwars-in-den-Weg the sea had still deepened the deep places which were there before; Saleier and Tempora had disappeared; the height of the waves at Merak was estimated from 30 m. to 40 m. by the chief of the works at Merak (*Nieuws van den Dag*, October 10).

The *Prins Hendrik*, a Dutch man-of-war (2000 tons, 400 h.p., 5·5 m. draft, 8 guns, 229 Europeans, 53 natives) was sent to the Sunda Straits for the safety of the vessels arriving there (*Nieuws van den Dag*, November 17). She first went to Vlakke Hoek, but could not communicate on account of the pumice-stone; another vessel succeeded in communicating (September 3), and found of the men of the lighthouse (5 Europeans, 14 coolies) 10 natives dead, 3 Europeans and 4 natives wounded. The base of the lighthouse is 2·5 m. above the level of the sea; the first (iron) floor was broken, the lodgings near the lighthouse swept away. The *Hendrik* observed that the north part of Krakatoa had disappeared; from the part which remained, from Verlaten and Lang Island, and the new ones (Calmeyer and Seers), smoke continually arose; now and then, by night, a flame was seen. September 16, the *Hendrik* tried to enter Semungka Bay. They found a place where the sea was not covered with pumice-stone, but landing was impossible, the breakers being too strong; next day a boat was sent again, which was beset in the floating masses. The pumice-stone around the *Hendrik* was now 5 feet thick, and one could stand on it. The boat had at last to be given up, the crew (being one lieutenant, Dutch Navy, two boatswains, fourteen sailors) went on shore. The *Hendrik* tried to leave the bay, but could hardly turn round; a condenser exploded, and they had to come to anchor. As far as they could see, the sea was covered with pumice-stone. After thirty hours the engine had been repaired and cleared, and after much trouble the steamer got out of the bay.

Though the reports which I have mentioned are far from being complete (I shall try to complete them), I think they are sufficient to draw some conclusions:—

1. As to the height of the wave, we have seen that the first waves at Anjer were more than 10 metres high (August 27, 6 a.m.). At Merak the height of the most destructive wave (by 9 o'clock) is estimated at 30–40 metres by the engineer himself, and Mr. McColl (the *Scotsman*, November 24) estimated it to be 135 feet (about 41 metres). At Telok Betong (Talang hills) it was about 23 or 24 metres, but here it was not properly speaking a wave, but it seems that the water in Lampong Bay was dammed up as it were. I suppose that the bay by the first waves was filled, and the mass of water broke here the force of the explosion, and the wave by which the latter was followed was turned to the east (from Merak the wave came from west). In general I do not

suppose that we may speak about "waves" in the ordinary sense. Besides the previous commotions, which were of course very strong, I suppose that by the explosion (let us say August 27, 9.30) an immense mass of water was driven to the north, and escaped as far as it could into the Java Sea; probably other concussions followed, and afterwards the mass flew back (this was the wave the *Berbice* met with at 3 o'clock), and went into the Indian Ocean. If this supposition be true, I think Vlakke Hoek lighthouse was also struck by the wave in the afternoon (which, of course, I do not know). That the water was really dammed up, we learn also—though the effect was not so strong—from the report from Telok Betong about August 26. The men, being on the pier, had to make their way home through the water, which at the time was rather high, and they could never have done it if there had at that moment been a flowing off of the wave. From different reports it results that the waves produced their effect in a certain direction, and not around (*e.g.* destruction in the night 26th to 27th, Sirah, south of Anjer; 26th, in the evening, destruction at Merak, only slight commotion at Anjer).

2. The barometer. From the *Berbice* it is reported: 28 to 30 inches, violently agitated. *Annesley:* rising

and falling ½ to 1 inch in half an hour. *Prinses Wilhelmina* at Tandjong Priok: 789–763mm. (*Nieuw. Rotterd.* Nov. 26) (789 seems a misprint, *Nieuws van den Dag* has 750, perhaps it should be 759). *Loudon:* extremely high.

3. Compasses. Spun round (*Loudon*).

4. Degree of darkness. From all reports results that there was a moment when "no outlines of ship or men were seen." From the report of the *Annesley* results that the darkness continued after the downpour of ashes had ceased, therefore the darkness is not depending on the pouring down of ashes; it is sufficient that the sunlight be intercepted by a thick cloud of ashes. From the *Berbice* is reported:—Darkness from 26th, p.m., to 28th, a.m. From all other places is reported:—Bright, August 27, from 6 to 9 a.m., and 28th, from 6 a.m.

5. After having read the reports, the question arose to me, Was the mud ejected from the crater, or were the ashes, &c., mixed with rain or sea water? I think the latter; I remember, at least, that in 1863 (an eruption of the Merapi, Java, took place) I came into a slight downpour of ashes. I was travelling on horseback, and after some time a thunderstorm came on. All around me, which had been ashes before, was changed very soon into mud. In the report of the *Berbice* the "rain of mud" is not mentioned, but it is said that the yards were covered with a "crust," because a slight rain had met the ashes, which, however, on deck were still "ashes," because, I suppose, the rain was not hard enough to change such a thick layer into a "crust."

6. Detonations, though they were heard in Saigon, Singapore, Acheen, Ceylon, &c., were not heard on board the *Loudon*. I think this might be explained by the thunderstorm, the pouring down of mud into the sea, and the hurricane (which in Lampong Bay did more damage than the wave itself).

7. The part of Krakatoa which has disappeared sank probably August 27; at least in the report from the *Loudon* the island is described as it is now. From the *Berbice*, however, it is reported:—Saw it divided in three parts (29th); but probably they saw the remains of Krakatoa, Verlaten Island, and Lang Island, which before, when seen from the east, appeared as one island.

8. Sibessie was from the sea to the top buried under ashes (all people killed).

9. The floating pumice-stone was, in the Lampong Bay, in September, 14 feet thick; in the Semungka Bay it was very strong too. Probably, if circumstances are favourable, new islands are to be formed; though at the end of October steamers came to Telok Betong, in November a hopper-barge was, during eleven days in the Lampong Bay, beset by pumice-stone.

Besides this I beg to record:—

10. After the eruption of Krakatoa in the Indies many volcanic phenomena were observed, and they prophesied an eruption of Mount Merapi (Java) for February next. Whether they had heard of Mr. Delaunay's prophecies I am unacquainted with.

11. Up to November 1 they counted 32,635 persons killed by the eruption, &c. For the burial of the corpses the Government had spent 6000*l*.

When the Survey under my direction (1868–69) was busy connecting the triangles of Java with the Sumatra coast, the peak of Krakatoa was also chosen for a point.

Whether there were several hills on the island I cannot say, for when I saw Krakatoa it was covered with a splendid vegetation, and in such a case it is not so easy to judge of the configuration as it is when the trees are burnt, but I dare say there was only one peak.

Of the results of the Survey I keep only a map, of which I inclose a rough copy. From this it results that the signal was a little to the north of 6° 8½′; Kuyper puts it in 6° 9′, which is certainly wrong; he inserts also a peak in the centre of the island (622 metres), and says it had disappeared; this is, I am sure, a mistake. If the military survey (which was at work now) had not yet finished its work so far as to give a map of Krakatoa (though perhaps they have not undertaken a survey of the island, since administratively it belongs to the Lampongs, and not to Bantam), it might perhaps be useful to consult the notes of the *Geographische Dienst*, which are deposited in the Archives, and a sketch of the Sunda Straits, which I offered in 1875 to the Minister of the Dutch colonies.

E. METZGER

Stuttgart, January

NOTES

WE regret to learn that Mr. C. W. Merrifield died at Brighton on New Year's Day at the age of fifty-six.

MANY of the friends of the late Dr. Hermann Müller in this country will be glad of the opportunity of testifying to their respect for his memory and their sense of the value of his work by contributing to the fund which is being raised to establish a "Müller Foundation." In the first instance the proceeds will be used to assist the widow of Dr. Müller during her lifetime, and afterwards as an endowment to some poor and deserving student at the Public School of Lippstadt desirous of devoting himself to natural science. An influential Committee has already been appointed on the Continent, including the name of Prof. Haeckel. The movement, we are sure, will commend itself to many of our readers, who may send their subscriptions either to Herr Stadtkaemmerer Wilhelm Thurmann, Lippstadt, or to the care of the Editor of NATURE.

FIVE HUNDRED POUNDS in prizes are offered by Mr. Francis Galton for extracts from the family records of competitors. They are to be sent him before May 15, drawn up according to the conditions and under the restrictions published in his recent book, "Record of Family Faculties" (Macmillan and Co., 2*s.* 6*d.*), which contains full explanations, together with sufficient blank forms for the records of a single family.

M. BOULEY has almost unanimously been appointed Vice-President of the Paris Academy of Sciences for 1884, and President for 1885.

EARTH tremors seem to have been of almost daily occurrence in Tasmania recently. Mr. J. R. Hurst of Longwood, near Moorina in the north-east of the colony, sends to the *Launceston Examiner* of November 12 a record extending from August 31 to October 20, 1883, noting the occurrence of several daily, some of them so serious as to be alarming. In a note in its issue of November 19 the *Examiner* says:—"The vibratory motions of the earth's surface which have been so frequent for several months past still continue with a periodicity which is at least remarkable. Ordinary tremors now scarcely arrest attention, but occasionally a quivering of unusual severity startles those who happen to notice it, and reminds them that there are forces in operation in nature which are mysterious and appalling. One of these occurred yesterday afternoon about six minutes to three o'clock, which was felt in every part of the town, and set windows and furniture rattling. Some persons fancied that they could detect a distinct undulatory motion. The shock lasted for twelve or fifteen seconds. It may be mentioned that the whole of yesterday was very stormy—frequent and heavy showers of rain, with thunder and hail, and a very low barometer. Last evening the mercury began to rise."

PROF. J. P. LICHERDOPOL writes from Bucharest, Roumania, that on January 1, at 6.13 a.m., two horizontal shocks of earthquake, from north to south and *vice versâ*, were felt there, and were preceded by a loud noise, as of a distant train coming from the north. The furniture was slightly shaken and crackings were heard. The atmosphere was calm, but charged with a very

thick and persistent fog.—Earthquake shocks were also felt during Sunday week in various parts of France. At Argèles (Hautes Pyrénées) there was one in the early morning, a second at nine o'clock, and a third about mid-day. At Dorignies, an industrial hamlet near Douai (Nord), the shock was sufficiently strong to cause real alarm. It occurred between six and seven in the evening. Houses shook, their timbers cracked, and glass and earthenware in cupboards were shattered.

THE Hungarian astronomer, Herr von Konkoly, who is mentioned as the future director of the Brussels Observatory, is expected to arrive there in about a week, for the purpose of explaining to the Science Department of the Belgian Academy his recent discovery relative to the cometary spectrum.

WE understand that Messrs. McLachlan and Fitch, having been appointed by the Entomological Society of London a committee for the purpose of examining, and reporting upon, certain vine-roots forwarded by the Government of Victoria, through Kew, find as the result of their examination that the *Phylloxera* is present in considerable numbers on the roots, which were those remaining in the ground after the vines themselves had been destroyed.

A TELEGRAM has been received from Prof. Hull, F.R.S., the chief of the Geological Expedition to the Holy Land, announcing the safe arrival of himself and his party at Gaza, where they are at present detained in quarantine. A letter, dated December 2, was also received from him a few days ago, which has been brought by camel post *viâ* Naklhl from Akabah, where the party arrived on November 27. In this letter Prof. Hull writes:—"We had every reason to be satisfied with the conduct of our Towârah Arabs. We spent three days in the neighbourhood of Jebel Musa, and made the ascent of the mountain, from the top of which Major Kitchener took angles to several prominent points; while on the same day Mr. Hart ascended Mount Catharina, a feat hitherto unperformed in one day, and was rewarded by finding several plants—representatives of colder climates. From Jebel Musa to Akabah we took the upper route, partially explored by Palmer. This has enabled us to add considerably to the accuracy of the geology and topography of the district; we have also taken a considerable number of photographs. On Saturday week we traversed a magnificent gorge cut through granite cliffs and extending for several miles, which, we believe, has not hitherto been described. It commences at the head of the Wady el Ain. We found the escarpment of the Tih much more broken and indeterminate than is represented in the maps, owing to the existence of several large faults or dislocations of the strata which traverse that district in a generally northerly and southerly direction, and we have finally determined the position of the leading line of fracture to which, at least, this portion of the Wady el Arabah owes its existence. Our course through to the Dead Sea by the valley is barred, owing to a blood feud between two tribes. We have, however, contracted with one of the tribes to be escorted as far as the Wady Musa and Petra, after which we shall strike off west across Tih Plateau to Gaza. This will enable us to do the greater part of the work in the Wady Arabah which we proposed. We are all in good health, and have made excellent collections to illustrate the botany, geology, and zoology of the district."

THE budget of the Ministry of Public Instruction in France reaches the unprecedented sum of six millions sterling. Half of this sum is absorbed by the primary and infant schools. The dotation for astronomy and meteorology is 40,000*l*., exclusive of municipal credits voted by Marseilles, Toulouse, Bordeaux, Lyons, for their astronomical observatories; Besançon, Clermont, Paris, and Toulouse, for Besançon, Puy de Dôme, Montsouris, and Pic du Midi meteorological establishments. The National Library of Paris receives 30,000*l*., and other public libraries in Paris, 11,000*l*; National Archives, 8000*l*. The pecuniary grants given to learned men amount to 8000*l*.; voyages and missions, 11,000*l*.; Collège de France, 20,000*l*.; Superior Normal School, 20,000*l*.; National Institute, 28,800*l*.; Academy of Medicine, 3000*l*.; School of Hautes-Etudes, 19,000*l*.; Faculté d'État (Universities), 400,000*l*.; Grammar Schools (Lycées), 319,000*l*.; Museum (Jardin des Plantes), about 40,000*l*.

THE following arrangements have been made for the meetings of the Society of Arts. The papers to be read at the ordinary meetings will be:—Electric Launches, by A. Reckenzaun; Science Teaching in Elementary Schools, by William Lant Carpenter; Coal Gas as a Labour-Saving Agent in Mechanical Trades, by Thomas Fletcher; Sanitary Progress, by B. W. Richardson, F.R.S.; The Progress of Electric Lighting, by W. H. Preece, F.R.S.; Forest Administration in India, by Dr. Brandis, F.R.S.; Reclamation of Land on the North-Western Coast of England, by Hyde Clarke; Water Regulation in England, by General Rundall; Telpherage, by Prof. Fleeming Jenkin, F.R.S.; New Process of Permanent Mural Painting (invented by Adolph Keim, Munich), by Rev. J. A. Rivington; Slate Quarrying, by W. A. Darbishire. At the meetings of the Sections the following papers will be read:—Foreign and Colonial Section—Canada as it will appear to the British Association in 1884, by Joseph G. Colmer, Secretary to the High Commissioner for Canada; The Portuguese Colonies of West Africa, by H. H. Johnston; Reflections on Chinese History, with reference to the present situation of affairs, by Demetrius G. Boulger; Borneo and its Products, by B. Francis Cobb; The Rivers Congo and Niger as Entrances to Mid-Africa, by R. Capper. Applied Chemistry and Physics Section—Manufacture of Gas from Limed Coal, by Prof. Wanklyn and W. J. Cooper; The Upper Thames as a Source of Water Supply, by Dr. Percy F. Frankland; Cupro-Ammonium Solution and its Use in Waterproofing Paper and Vegetable Tissues, by C. R. Alder Wright, F.R.S.; Economic Applications of Seaweed, by Edward C. Stanford. Indian Section—State Monopoly of Railways in India, by J. M. Maclean; The New Bengal Rent Bill, by W. Seton-Karr; Trade Routes in Afghanistan, by Griffin W. Vyse; The Existing Law of Landlord and Tenant in India, by W. G. Pedder. The courses of Cantor lectures will be on Recent Improvements in Photo-Mechanical Printing Methods, by Thomas Bolas; The Building of London Houses, by Robert W. Edis, F.S.A.; The Alloys used for Coinage, by Prof. W. Chandler Roberts, F.R.S., Chemist of the Royal Mint; Some New Optical Instruments and Arrangements, by J. Norman Lockyer, F.R.S.; Fermentation and Distillation, by Prof. W. Noel Hartley.

THE Portuguese explorers, Senhores Capello and Ivens, have just sailed for West Africa. They proceed first to Loanda, thence northward to Zaire. It is expected that they will be absent for about two years.

M. ACHARD's continuous electric brake has been worked successfully in competition with the Westinghouse and other systems. The electricity is obtained by a dynamo worked by the train itself, and can give light for signals and other purposes, when worked by the engine. The sliding valve of locomotives for admitting steam has been replaced by a piston, which renders similar service. A large diminution of friction and wear results from this improvement. The economy in coals is stated to have been 5 per cent.

DR. NACHTIGAL, the well-known African traveller, who is now German Consul-General at Tunis, has received the gold medal for Art and Sciences from the Grand Duke of Mecklenburg-Schwerin.

THE members of the International Polar Commission will meet in Vienna early in May next, where preparations for this meeting are already being made.

THE death is announced of Dr. Wilhelm Gintl, an eminent telegraph engineer, and formerly director of all Austrian telegraphs. He died at Prague on December 22, 1883, aged eighty years.

LIEUT. WOHLGEMUTH, the leader of the Austrian Polar Expedition, has read a paper on the results of the Expedition at the last meeting of the Viennna Geographical Society; 124 auroræ were observed, amongst which about ten were crown-shaped. Amongst the old lava streams and in the crevices of the numerous craters of the island of Jan Mayen, Lieut. Wohlgemuth found traces of a still progressing volcanic activity, and three times observed well-marked subterraneau shocks.

A SERIES of ornithological observatories has been established throughout Austria-Hungary at the instance of Crown Prince Rudolf, with a view of paying special attention to the migrations of birds, as well as to their breeding habits. The work done by these stations is satisfactory enough; yet it has been found that a complete insight into the periodical movements of birds cannot be obtained so long as similar stations are not spread over the whole globe. The subject is to form one of the principal topics for discussion at the approaching Ornithological Congress, which will be held under the auspices of the Crown Prince at Vienna on April 16 next and the following days.

AT Cobern, near Coblenz, a Franconian burial-ground has been discovered, containing many objects of interest, such as ornaments, weapons, glass and clay vases, stones with inscriptions, &c.

THE Turin Academy of Sciences has given a prize (480*l.*) to Mr. Hormuzd Rassam for his discoveries in the domain of Assyrian and Babylonian antiquities.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus* ♀) from India, presented by Madame Kettner; two Rhesus Monkeys (*Macacus rhesus* ♂ ♀) from India, presented by Mr. G. Glyn Petre, F.Z.S.; a White-throated Capuchin (*Cebus albifrons* ♀), a Crab-eating Opossum (*Didelphys cancrivora*) from the West Indies, presented by Lady Brassey, F.Z.S.; a Common Genet (*Genetta vulgaris*) from West Africa, presented by Capt. A. North Daniel; a Canadian Porcupine (*Erithizon dorsatus*) from North America, presented by Mr. A. Glidden; a Kinkajou (*Cercoleptes caudivolvulus*) from Brazil, presented by Dr. Byres Moir; a Ring-hals Snake (*Sepedon hæmachates*), a Robben Island Snake (*Coronella phocarum*), an Egyptian Cobra (*Naia haje*), a Rhomb-marked Snake (*Psammophylax rhombeatus*), a Many-spotted Snake (*Coronella multimaculata*), a Hissing Sand Snake (*Psammophis sibilans*), a Smooth-bellied Snake (*Homalosoma lutrix*), a Spotted Slow-worm (*Acontias meleagris*) from South Africa, presented by the Rev. G. H. R. Fisk, C.M.Z.S.; two Gold Pheasants (*Thaumalea picta* ♂ ♀) from China, two Common Peafowls (*Pavo cristatus* ♂ ♀) from India, deposited; five Knots (*Tringa canutus*), a Common Guillemot (*Lomvia troile*), British, purchased.

OUR ASTRONOMICAL COLUMN

THE SOLAR MOTION IN SPACE.—The recently published volume of the *Memoirs of the Royal Astronomical Society* contains a paper by Mr. W. E. Plummer, of the Oxford University Observatory, on the Motion of the Solar System. The data on which the author has founded his discussion are the proper motions of the stars in the southern hemisphere, as determined by Mr. Stone in the Cape Catalogue. The work is therefore a repetition and extension of the inquiry conducted by the late Mr. Galloway, and it would appear that the necessity of a re-discussion was suggested to Mr. Plummer by the discordances between the values of the proper motions there employed and those given by Mr. Stone. To illustrate the uncertainty in the result, particularly when based upon an insufficient number of stars, the position of the apex of the solar system is first derived from the same list of stars as that used by Mr. Galloway, but with improved values of the proper motion. The more trustworthy result from these restricted data places the apex in the constellation Ophiuchus some thirty degrees south of the generally received position.

Incorporating, however, all the southern stars whose known proper motions exceed one-tenth of a second (which raises the number of stars employed to 274), a more accordant result is obtained. If the apparent magnitude be adopted as a criterion of distance, and the irregularities of proper motion be supposed due to the peculiar motions of the stars themselves, the co-ordinates of the apex are $\alpha = 270^\circ\ 8'$, $\delta = +\ 20^\circ\ 20'$, and the annual motion of the sun, viewed from the mean distance of the first magnitude stars, subtends an arc of $1''\cdot690$. Unfortunately, if the corrections computed on this supposition be applied to the individual proper motions, the sum of the squares of the residuals is slightly larger than the sum of the squares of the original motions.

Selecting as a second hypothesis the suggestion that the distances of the stars vary inversely as their proper motions, the position of the apex is given in $\alpha = 276^\circ\ 8'$ and $\delta = +\ 26^\circ\ 31'$, and the annual motion of the sun seen from the distance of stars whose annual proper motion is about $1''\cdot5$ seconds of arc, is $0''\cdot926$. Introducing the necessary corrections, the sum of the squares of the proper motion in R.A. is reduced from $124''\cdot9$ to $70''\cdot4$, and in declination from $54''\cdot6$ to $39''\cdot3$, a result that tends to support the reality of the second hypothesis.

THE LATE M. YVON VILLARCEAU. — Antoine-François-Joseph-Yvon Villarceau was born at Vendôme on January 15, 1813. He first studied in the local college, and subsequently went through the course of instruction at the Conservatoire in Paris, where, in 1833, he gained a first prize. In the same year he proceeded to Egypt with Félicien David, and joined the mission under Enfantin: in this way his attention was directed to engineering. Returning to France in 1837 he was admitted to the École Centrale, which he left in 1840, being then first in the Mechanical Section. Already possessed of an independent fortune, in the years immediately following he was chiefly occupied with mathematical studies, with the view to qualify himself for the higher branches of mechanics and astronomy. In 1845 his first memoir upon comets, which was judged worthy of insertion in the "Recueil des Savants Etrangers," brought him under the notice of Arago, who, impressed with the originality of his ideas, offered him, in 1846, a place at the Observatory of Paris, to which establishment he was attached until the close of his life, at first as assistant, and since 1854 as titular astronomer. Villarceau was the author of a large number of memoirs upon mechanical and geodetical subjects, amongst others, on the stability of locomotives in motion, and on the theory of arches, accompanied by extensive tables and numerous practical applications, on the theory of the gyroscope of Foucault, and the compensation of chronometers; he made geodetical determinations in France between 1861 and 1865, which led to several important deductions. Amongst his earlier astronomical work was the development and application of a new method of investigating the orbits of the revolving double-stars, which he applied to η Coronæ Borealis and other binaries; this was followed by a memoir on the determination of the orbit of a planet, founded on the method of Laplace. In 1851, on the discovery by D'Arrest of the short-period comet which bears his name, Villarceau determined the orbit rigorously, and by means of his predicted places the comet was again observed, in 1857, by Maclear at the Cape of Good Hope. It was upon his plans that, while Leverrier was in direction of the Observatory of Paris, the great equatorial in the west tower, which constituted a notable advance in the construction of such astronomical instruments, was erected. Villarceau died on December 23. At the funeral discourses were delivered by Col. Perrier in the name of the Academy of Sciences (of which Villarceau had been a member, in the Section of Hydrography and Navigation, since 1867); by M. Faye in the name of the Bureau des Longitudes; and by M. Tisserand in that of the Paris Observatory.

THE ENGLISH CIRCUMPOLAR EXPEDITION[1]

ON April 14, 1882, I was informed that I was appointed to the command of the Circumpolar Expedition. I at once proceeded to London, and was occupied until the day of sailing in practice with the magnetic instruments at the Kew Observatory, and the purchase of stores, &c., for the expedition.

On May 1 Sergeant F. W. Cooksley, Royal Horse Artillery, and Gunner C. S. Wedenby, Royal Artillery, and on May 6 Sergeant Instructor of Gunnery J. English, R.H.A., reported themselves to me, and commenced attendance at Kew for instruction.

Journey to Fort Rae.—We sailed from Liverpool on May 11, and arrived at Quebec on the 23rd. Here I spent some days, finding that the steamer for the north did not leave Winnipeg till June 10, and my party was very kindly afforded quarters in the citadel by Lieut.-Col. Cotton, commanding the Canadian Artillery at that place.

Having obtained a free pass for our baggage on the Grand Trunk Railway, I started at once for Winnipeg, proceeding by the lakes, that being the cheaper route, and the one which, on the whole, exposed the instruments to the least knocking about.

We reached Winnipeg on June 9, and left on the following day by the *Saskatchewan* steamer. On June 26 we reached Carlton, where it was necessary to engage carts to take our baggage to Green Lake, a distance of 140 miles.

On the 29th the carts were taken across the river, and on the 30th we started for Green Lake, which we reached on July 9, having been delayed by the extreme badness of the road. The heat of the weather also rendered a long halt necessary in the middle of the day, and the flies prevented our animals from feeding properly, incapacitating them for long marches or fast work, and on one occasion forcing us to halt for a whole day, the oxen being so worried by them as to be unable to march.

At Green Lake we entered upon the system of water communication that forms the only roadway in the north, and by way of Portage la Loche, and the Clearwater and Athabasca Rivers, we reached Fort Chipewyan on July 30. Here we had to await the Mackenzie River boats, there being no other means of reaching Fort Rae, and it was not until August 17 that we were able to start on this last stage of our journey. We reached Great Slave Lake on the 22nd, on the evening of which day a gale arose which stove in and sunk our boat, damaging most of our provisions. Fortunately we were able to repair the boat, but it was not until the 25th that the weather allowed us to proceed, and on the 27th we were again detained by a fresh storm, so that it was not until 10 p.m., on August 30, that we arrived at Fort Rae.

Fort Rae.—Fort Rae is situated in lat. 62° 38′ 52″ N., and long. 115° 43′ 50″ W., at the south-west extremity of a peninsula that juts out from the north-east shore of a long gulf running in a north-westerly direction for more than 100 miles from the northern shore of the Great Slave Lake. It is almost entirely surrounded by water, as shown in the annexed plan. The formation is limestone. The land rises to a height of some 200 feet, and it is covered in part with moss, in part with pines and scanty brushwood. A few vegetables are grown in the summer in the garden attached to the Roman Catholic Mission, but for food the inhabitants chiefly depend upon the produce of the nets, and on deer, which are brought in by the Indian hunters attached to the post.

On arrival it was found that the magnetic instruments required a good deal of setting to rights, their boxes being filled with water and the fittings loosened, so that not a single instrument was quite in working order. There was, moreover, no building ready for their reception, so that it was not possible to keep August 31—September 1, as a term day, but we succeeded in getting the meteorological instruments in position so as to commence observations with them at midnight on the 31st.

We were fortunate in finding a building that admitted of conversion into a magnetic observatory, it only requiring a floor, fireplace, door, and windows to be habitable. This work was at once commenced, and on September 3 the declinometer, on the 4th the bifilar, and on the 6th the vertical force magnetometer were mounted in their places. This observatory was finished on September 10, and another one commenced for astronomical and absolute magnetic observations, the continual wind rendering out-door observations unsatisfactory.

[1] "Report on the Circumpolar Expedition to Fort Rae," by Capt. H. P. Dawson, R.A. Communicated to the Royal Society by Prof. G. G. Stokes, Sec. R.S.

The men of my party were accommodated in the house of one of the sub-officers of the fort, and I had a room in the house of the Hudson's Bay Company's officer in charge.

The instruments, on the whole, suffered but little from the journey. One barometer and one thermometer were broken, and the object glasses of the telescopes of most of the magnetic instruments were nearly opaque, the cement joining the two lenses having, from some cause or other, melted on the journey. Our provisions were more damaged, 190 lbs. of sugar, 30 lbs. of tea, all our rice, and most of our baking powder having been destroyed.

The observations were then carried on without interruption until August 31, 1883.

Magnetic Observations.—The balance magnetometer was the only magnetic instrument whose performance was not satisfactory, as not only did it frequently get out of adjustment, but in times of magnetic disturbance it often vibrated through so large an arc that exact reading was impossible. The other instruments were remarkably free from vibration, and there was never any difficulty in reading them, but it was found necessary to extend the scale of the bifilar on the side of decreasing force, owing to the great movements of this instrument.

The greatest magnetic disturbance was on November 17, 18, and 19, 1882, when all the instruments moved at times beyond the limits of their scales. On the first of these days the difference between the extreme easterly and westerly positions of the declinometer magnet exceeded 10°.

Aurora.—Aurora was observed on almost every clear night, and was usually attended by more or less magnetic disturbance. It did not appear to me, however, that the two phenomena stood in the relation of cause and effect, but rather that they were both due to a common cause. The most marked instance of connection between the two phenomena consisted in a rapid decrease in both vertical and horizontal magnetic forces which attended a sudden outburst of aurora in the zenith. This was observed on several occasions. The bifilar almost always showed a reduction of horizontal force during a display of aurora. I also think that the declinometer magnet tended to point towards the brightest part of the aurora, but that (*sic*) I have not yet had time to make that careful comparison of the auroral and magnetic observations which will be required to decide this point. It was found impossible to obtain photographs either of the aurora or of its spectrum—the latter invariably presented the characteristic yellowish green line, and occasionally, but rarely, several other bright lines were visible for a few moments towards the violet end of the spectrum, and once a bright band was seen in the red.

I was also unsuccessful in my attempts to measure the height of the aurora, chiefly from the want of a well defined point to measure to, also from the fact that some hours were required to prepare for this observation, whereas the appearance of a suitable aurora could not be predicted, and was, in fact, not of frequent occurrence, and then often only lasting a few seconds. For this observation two stations some miles apart should be connected by telegraph and occupied for many days, or even weeks, in succession.

Although I paid attention to the point, I never heard any sound from the aurora save on the occasion mentioned in a former memorandum, but I made many inquiries on the subject from residents in the country, both English and French, and their statements agree so well, both with one another and with what I myself heard, that I am forced to conclude that the aurora is at times audible, and that on these occasions it appears to be, and probably is, very near the earth.

Meteorological Observations.—With regard to the meteorological observations, the station was somewhat unfavourably placed for observations of wind, on account of the hill to the north-east, but as winds from this quarter were rare, the effect on the results will not be great, especially as one of the anemometers was on an island in the lake, in an entirely open situation.

The anemometers did not work quite satisfactorily, being at times choked by ice; but I hope by the comparison of the two satisfactory results may be attained.

The wind was usually either south-east or north-west; and when it blew from the former quarter, the motion of the upper clouds often showed the existence of a north-westerly current.

The hair hygrometers were found to be useless out of doors in cold weather, on account of the formation of ice on the hair.

The earth thermometers were read every alternate day: the observations were interrupted by a carcajou, or other animal,

which extracted the thermometers from their tube for the sake of the fur in which it has been found necessary to envelop them, and broke them all; other thermometers were, however, substituted, and the observations continued. It was found impossible to obtain the temperature of the soil at a greater depth than four feet, on account of the rocky nature of the ground.

A series of observations of terrestrial radiation was made by means of a thermometer placed on the surface of the snow, but the almost continual wind detracts much from the value of these readings.

I was told by the residents of the country that the year was an unusually dry one, and certainly the rainfall is remarkably small; they also said that the winter was particularly mild and free from storms, which, from all accounts, and from the journals kept at the fort, seem to be both frequent and severe; as it was, we only experienced one, in February.

Astronomical Observations.—My first determination of the longitude was made by means of lunar distances, and time was found by the method of equal altitudes, but after the observatory was finished both these points were determined by transits, and the first value of the longitude found to be more than a minute in error. The latitude was determined by transit observations in the prime vertical, and is probably within a few seconds of the truth. The longitude may be ten seconds in error. The time was generally correct to within three or four seconds.

A more solidly constructed transit instrument would have been desirable, as it was found that in the cold weather it required so much force to move the telescope of the transit theodolite on its axis that there was great risk of disturbing the adjustments of this instrument, composed as it is of so many parts.

Food, &c.—Our supply of provisions proved quite sufficient. I had brought enough flour to admit of my issuing the usual ration of ¾ lb. per diem, and tobacco 1 lb. per month to each man. We also had a supply of Chollet's preserved vegetables, and a reserve stock of bacon, besides tea and sugar. Of the latter we were somewhat short, owing to the loss sustained on the journey up. We usually had fresh meat throughout the winter; in the summer we were occasionally reduced to dried meat. During the journey there and back we chiefly lived on pemmican. The Rev. Père Roure, of the Roman Catholic Mission, most kindly furnished us with fresh vegetables and potatoes throughout the summer.

The conduct of the men under my command was everything that could be desired. They took great interest in the observations, and did their best to carry them out with accuracy and punctuality, and were always contented and cheerful, in spite of the inevitable discomforts of their winter quarters and the occasional hardships of the journey.

Return Journey.—We were running great risks of being overtaken by the winter, and therefore lost no time in our departure.

The last hourly observation was made at midnight on August 31, 1883, after which the instruments were dismounted and packed, their cases having been previously arranged in readiness outside the observatory. The remainder of the baggage was already in the boat, so that by 2.30 a.m. on September 1 we were *en route*, and reached Fort Chipewyan on September 17, and Portage la Loche on October 4, having experienced some delay in surmounting the rapids of the Clearwater, the hard frosts having frozen all the small tributary streams, thus considerably lowering the water in the river.

The boat awaiting us on the south side of the portage was frozen in, but fortunately the wind changed and the ice broke up before our arrival. Had it been otherwise, we must have waited until the rivers were thoroughly frozen and travelling with dog-trains possible. In that case we should have been compelled to abandon our instruments and baggage.

On the 21st we reached Carlton on the Saskatchewan, where we were detained a day, the man engaged to transport our baggage across the prairie having refused to proceed. Another man was engaged, and on October 31 we reached the railway at Qu'Appelle, arriving at Winnipeg the following day. We were fortunate in crossing the prairie with so little difficulty, as at the same time last year it was covered with three feet of snow.

At Winnipeg I remained a couple of days to adjust accounts with the Hudson's Bay Company, and on November 4 we started for Quebec, going by rail *via* Chicago. We reached Quebec on the 8th, and Liverpool on November 20.

In conclusion, I have to acknowledge the assistance received from the officers of the Hudson's Bay Company, who spared no trouble in carrying out my wishes, especially Chief Commissioner Grahame at Winnipeg, Chief Factors MacFarlane and Camsell in charge of the Athabasca and Mackenzie River Districts respectively, and Mr. King in charge at Fort Rae. To their hearty co-operation the success of the expedition is in great part due.

Results of Expedition.—The following is a list of the observations taken at Fort Rae, the result of our year's work there, which I have now the honour to lay before the Royal Society:—

Magnetic

Hourly—
Declination from September 3, 1882, to August 31, 1883.
Hor. Force ,, 4, ,, ,,
Vert. Force ,, 6, ,, ,,

Term Day—
In accordance with programme laid down by St. Petersburg Conference—from September 15, 1882, to August 15, 1883.

Occasional—
Absolute observations of Hor. Force Dip and Declination.

Meteorological

Hourly—
Barometer from Sept. 1, 1882, to Aug. 31, 1883.
Dry and Wet Bulb Therms. ,, ,, ,,
Anemometer ,, ,, ,,
Wind, Clouds, and Weather ,, ,, ,,
Aurora (when visible) ,, ,, ,,
Hair Hygrometer (when in working order).
Terrestrial Radn. (occasionally in clear weather).

Daily—
Max. and Min. Solar and Terrest. Radn. Therms.
Rain Gauge.

Earth Thermometers every two days.

THE EVIDENCE FOR EVOLUTION IN THE HISTORY OF THE EXTINCT MAMMALIA[1]

II.

COMING to the vertebræ as a part of the osseous system, I will mention the zygapophyses, or antero-posterior direct processes, of which the posterior looks down and the anterior looks up. They move on each other, and the vertebral column bends from side to side. In the lower forms of mammals they are always flat, and in the hoofed mammals of the Puerco period they are all flat. In the Wasatch period we get a single group in which the articulation, instead of being perfectly flat, comes to be rounded; in the later periods we get them very much rounded; and finally, in the latest forms, we get the double curve and the locking process in the vertebral column, which, as in the limb, secures the greatest strength with the greatest mobility. In the first stages of the growth of the spinal cord it is a notochord or a cylinder of cartilage or softer material. In later stages the bony deposit is made in its sheath until it is perfectly segmented.

Now all the Permian land animals, reptiles, and batrachians retain this notochord with the beginnings of osseous vertebræ in a greater or less degree of complexity. There are some in South Africa, I believe, in which the ossification has come clear through the notochord, but they are few. This characteristic of the Permian appears almost alone—perhaps absolutely alone as regards land animals. There is something to be said as to the condition of that column from a mechanical standpoint, and it is this: that the cord exists, its osseous elements disposed about it; and in the batrachians related to the salamanders and the frogs, these osseous elements are arranged under the sheath in the skin of the cord, and they are in the form of regular concave segments, very much like such segments as you will take from the skin of an orange—parts of spheres, and having greater or less dimensions according to the group or species. Now the point of divergence of these segments is on the side of the column. They are placed on the side of the column where the segments separate—the upper segments rising and the lower segments coming downward. To the upper segments are attached the arches and their articulations; and the lower segments are like

[1] A lecture by Prof. E. D. Cope of Philadelphia, given in general session before the American Association for Advancement of Science at Minneapolis, August 20, 1883. Stenographically reported for *Science*.
Continued from p. 230.

the segments of a sphere. If you take a flexible cylinder and cover it with a more or less inflexible skin or sheath, and bend that cylinder sidewise, you of course will find that the fractures of that part of the surface will take place along the line of the shortest curve, which is on the side; and, as a matter of fact, you have breaks of very much the character of the segments of the Permian batrachia. It may not be so symmetrical as in the actual animal, for organic growth is symmetrical so far as not interfered with; for, when we have two forces, the one of growth and the other of change or alteration, and they contend, you will find in the organic being a quite symmetrical result. That is the universal rule. In the cylinder bending in this way, of course the shortest line of curve is right at the centre of the side of that cylinder, and the longest curve is of course at the summit and base, and the shortest curve will be the point of fracture. And that is exactly what I presume has happened in the case of the construction of the segments of the sheath of the vertebral column in the lateral motion of the animal swimming always on one side, and which at least has been the actual cause of the disposition of the osseous material in its form. I have gone beyond the state of the discussion in calling attention to one of the forces which have probably produced this kind of result. That is the state of the vertebral column of many of the vertebrata of the Permian period.

I go back to the mammalia, and call attention to the teeth. The ordinary tooth of the higher type of the mammalia, whether hoofed or not, with some exceptions, is complex with crests or cusps. In cutting the complex grinding surfaces we find they have been derived by the unfolding extensions of four original cusps or tubercles. They have been flattened, have been rendered oblique, have run together, have folded up, have become spiked, have descended deeply or have lifted themselves, so that we have teeth of all sorts and kinds, oftentimes very elegant, and sometimes very effective in mechanism. In many primary ungulates, the primitive condition of four conical tubercles is found. In passing to older periods we find the mammalia of the Puerco period, which never have more than three tubercles, with the exception of three or four species. In the succeeding periods, however, they get the fourth tubercle on the posterior side. Finally, you get a complicated series of grinding or cutting apparatus, as the case may be.

Last, but not least, we take the series of the brain. No doubt the generalisation is true, that the primitive forms of mammalia had small brains with smooth hemispheres; later ones had larger brains with complex hemispheres. In general, the carnivora have retained a more simple form of brain, while herbivorous animals have retained a most complicated type of brain. The lowest forms of mammalia display the additional peculiarity of having the middle brain exposed, and the hemispheres or large lobes of the brain, which are supposed to be the seat of the mental phenomena, are so reduced in size at the back end that you see the middle brain distinctly, though it is smaller than in reptiles and fishes. It is beyond the possibility of controversy that these series have existed, and that they have originated in simplicity, and have resulted in complication; and the further deduction must be drawn, that the process of succession has always been towards greater effectiveness of mechanical work. There are cases of degradation, as in the growing deficiency in dentition in man. There is no doubt that a large number of people are now losing their wisdom-teeth in both jaws.

We are now brought to the question of the relations which mind bears to these principles. The question as to the nature of mind is not so complex as it might seem. There is a great deal of it, to be sure; but on examination it resolves itself into a few ultimate forms. An analysis reduces it to a few principal types or departments—the departments of intelligence and of emotions (with their modified smaller forms, likes and dislikes), and the will, if such there be. Those three groups, proposed by Kant, are well known, and adopted by many metaphysicians; and they stand the scrutiny of modern science perfectly well in both men and the lower animals. But the question of the material of the mind, the original raw stuff out of which mind was made, is one which is claiming attention now from biologists, as it always has done from physiologists proper and physicians. This is sensibility, mere simple sensibility, unmodified sensibility, or consciousness. Sensibility, in connection with memory, is sufficient for the accomplishment of wonderful results. It is only necessary to impress the sensibility with the stimuli which this world affords, whether from the outside or the inside, to have the record made, and to have the record kept. Among wonderful things this is perhaps the most wonderful: that any given form of matter should be able to retain a record of events, a record which is made during a state of sensibility for the most part, a greater or less degree of sensibility, which is retained in a state of insensibility, and is finally returned to the sensibility by some curious process of adhesion, and the results of impresses which are found on the material tissue concerned.

And these simple elements of mind are found in animals. No zoologist who has perception or honesty, nor any farmer or breeder, nor any person who has charge of animals in any way, can deny sensibility to all the lower animals at times. The great stumbling-block in the way of the thinker in all this field is the great evanescence of this sensibility: the great ease with which we dissipate it, the readiness with which we can deprive a fellow-being of his sense, is a stumbling-block in more ways than one. While it is a question of the greatest difficulty, nevertheless, like other departments of nature, doubtless it will ultimately be explained by the researches of physiologists. I only need to call attention to the fact as an important factor in evolution.

Of course, if these structures are suggested, affecting the mechanical apparatus, the question arises whether they were made ready to hand, whether the animal, as soon as he got it, undertook to use it, and whether he undertook to use the organism under the dire stimuli of necessity, or amended through ages these modifications in his own structure. We are told by some of our friends that law implies a Lawgiver, that evolution implies an Evolver; the only question is, Where is the Lawgiver? where is the Evolver? where are they located? I may say, it is distinctly proven in some directions, that the constant applications of force or motion in the form of strains, in the form of impacts and blows, upon any given part of the animal organism, do not fail to produce results in change of structure. I believe the changes in the ungulates to which I have called your attention are the result of strains and impacts, precisely as I have shown you the manner of the fracture of the vertebral column of the primitive vertebrates of the Permian period. This would require long discussion to render clear; nevertheless I venture to make the assertion that this series of structures is the result of definite and distinct organic forces, directed to special ends. We have yet to get at the conflicting forces which have produced the results we see. Mechanical evolution will give us a good deal to do for some time to come. Of course, if motion has had an effect in modifying structure, it behoves us to investigate those forces which give origin to motion in animals. First in order come the sensibilities of the animal, which we have traced to simple consciousness; stimuli, upon notice of which he immediately begins to move. The primary stimulus of all kinds of motion is necessarily touch. If a stone falls upon the tail of some animal which has a tail, he immediately gets out of that vicinity. If a jellyfish with a stinging apparatus runs across an eel which has no scales, the eel promptly removes. External applications of unpleasant bodies will always cause an animal to change his location. Then he is constantly assaulted by the dire enemy of beasts, hunger, which is an instinct which is evidently universal, to judge from the actions of animals. This seems to have fashioned, in large part, all forms of life, from the least to the greatest, from the most unorganised to the most complex. Each exercised itself for the purpose of filling its stomach with protoplasm. Then come the stimuli, which should be included under the class of touch, changes of temperature. No animals like to be cold or too hot; and when the temperature is disagreeable the tendency is to go away from that locality. Among primary instincts must be included that of reproduction. After that comes the sensation of resistance, or, carried to a high degree, of anger: when an animal's interests are interfered with, its movements resisted, it prompts to the most energetic displays. So you see it is a matter of necessity that mental phenomena lie at the back of evolution, always provided that the connecting link of the argument—that motion has ever affected structure—be true. That is a point which of course admits of much discussion. I have placed myself on the affirmative side of that question; and, if I live long enough, I expect to see it absolutely demonstrated.

Of course the development of mind becomes possible under such circumstances. It is not like a man lifting himself up by his boots, which it would be if he had no such thing as memory. But with that memory which accumulates, which formulates first habits, and then structures, especially in the soft, delicate

nervous tissue, the development of the mind as well as the machinery of the mind becomes perfectly possible. We develop our intellect through the accumulation of exact facts, through the collation of pure facts, no matter whether it be a humble kind of a truth—as the knowledge of the changes of the seasons, which induces some animals to lay up the winter's store—whether it be knowledge of the fact that the sting of the bee is very unpleasant, or knowledge of the fact (of which the ox, no doubt, is thoroughly aware) that the teeth of the wolf are not pleasant to come in contact with, or whether it be the complex knowledge of man. When the cerebral matter has become larger and more complex, it receives and retains a much greater number of impressions, and the animal becomes a more highly educated being.

As regards the department of emotions or passions, it is also much stimulated by the environment. Animals which live in a state of constant strife naturally have their antagonistic passions much developed, while amiable, sympathetic sentiments are better and more largely produced by peace-loving animals. Thus it is that the various departments of the mind have the beautiful results which we now find in the human species.

There are some departments of the mind which some of our friends decline to admit having had such an origin. The moral faculty, for instance, is excepted by many from this series. But the reasons why they object to its production in this way are, to my mind, not valid. The development of the moral faculty, which is essentially the sense of justice, appears to them not to fall within the scope of a theory of descent or of evolution. It consists of two parts. First is the sentiment of benevolence, or of sympathy with mankind, which gives us the desire to treat them as they should be treated. It is not sufficient for justice that it is unmixed mercy, or benevolence, which is sometimes very injurious, and very often misplaced. It requires, in the second place, the criticism of the judgment, of the mature intellect, of the rational faculty, to enable the possessor to dispose of his sentiments in the proper manner. The combination of rational discrimination and true judgment with benevolence constitutes the sense of justice, which has been derived, no doubt, as a summary of the development of those two departments of the mind, the emotions and the intellect.

It is said that a sense of justice could not be derived from the sense of no justice; that it could not have been derived from the state of things which we find in the animals, because no animal is known to exhibit real justice: and that objection is valid as far as it goes. I suspect that no animal has been observed to show a true sense of justice. That they show sympathy and kindness there is no question; but when it comes to real justice they do not display it. But do all men display justice? Do all men *understand* justice? I am very sure not. There are a good many men in civilised communities, and there are many tribes, who do not know what justice is. It does not exist as a part of every mental constitution. I never lived among the Bushmen, and do not know exactly what their mental constitution is; but in a general way the justice of savages is restricted to the very smallest possible circle—that of their tribe or of their own family. There is a class of people who do not understand justice. I do not refer to people who know what right is, and do not do it; but to the primitive state of moral character, in which, as in children, a sense of justice is unknown. I call attention to the fact because some of our friends have been very much afraid that the demonstration of the law of evolution, physical and metaphysical, would result in danger to society. I suspect not. The mode in which I understand this question appears to me to be beneficial to society, rather than injurious; and I therefore take the liberty of appending this part of the subject to its more material aspect.

To refer to another topic, and that is to the origin of life, the physical basis of life. The word "life" is so complex that it is necessary to define it, and so to define it away that really the word "life" does not retain its usual definition. Many phenomena of life are chemical, physical, mechanical. We have to remove all these from consideration, because they come within the ordinary laws of mechanical forces; but we have a few things left which are of a different character. One is the law of growth, which is displayed in the processes of embryonic succession; secondly, the wonderful phenomena of sensibility. Those two things we have not yet reduced to any identity with the ordinary laws of force. In the phenomena of embryology the phenomena of evolution are repeated, only concentrated in the early stages through which animals have to pass. So whatever explains the general phenomena of evolution explains the phenomena of embryology.

What is the nature of physical sensibility? In this planet it is found residing only in one form of matter which has a slightly varied chemical constitution, namely, protoplasm; so called from a physical standpoint. Now this world, as you all know, has passed through many changes of temperature. Its early periods, it is probable, were so very hot that protoplasm had a very poor chance. The earth has passed through a great many changes of temperature, many of which would not permit the existence of protoplasm. Again, can we assume for a moment that this little speck in the great universe is the only seat of life? I suppose scarcely any scientific man will venture to do so. If, therefore, life exists in other parts of this great universe, does it necessarily occupy bodies of protoplasm in those different, remote spheres? It would be a great a sumption. It is altogether improbable. The certainty is that in those planets which are in proximity to the sun's heat there could be no protoplasm. Protoplasm in the remote planets would be a hard mineral, and near the sun it would be dissipated into its component gases. So that, if life be found in other parts of this universe, it must reside in some different kind of material. It is extremely probable that the physical conditions that reside in protoplasm might be found in other kinds of matter. It is in its chemical inertness and in its physical constitution that its adaptation to life resides; and the physical constitution necessary for the sustentation of life may be well supposed to exist in matter in other parts of the universe. I only say the door is open and not closed: any one who asserts that life cannot exist in any other material basis than protoplasm is assuming more than the world of science will permit him to assume. And that it is confined to this single planet, and not in the great systems of the universe,—that assumption will not for a moment be allowed. Therefore the subject is one which allows us a free field for future investigation: it is by no means closed in the most important laws which it presents to the rational thinker. I hope, therefore, if the evidence in favour of this hypothesis of the creation of living forms be regarded as true, that no one will find in it any ground for any very serious modification of existing ideas on the great questions of right and wrong, which have long since been known by men as a result of ordinary experience, and without any scientific demonstration whatsoever.

THE REMARKABLE SUNSETS

WE have received the following further communications on this subject:—

REFERRING to Mr. Meldola's letter in your last number (p. 224), I beg leave to state that I likewise observed an astoni-hing atmospheric luminosity, out ide of this town, at 2–3 a.m. in the moonless and foggy night of January 1–2. It is reported that in these days the "Dämerungserscheinungen" have again been very striking at many places in Germany. Here the state of the atmosphere has of late been unfavourable for observing these phenomena; their most brilliant display, a "red glow" of oextraordinary extent and intensity, I witnessed on the morning of December 1, beginning about two hours before sunrise.

The view that these luminosities are caused by volcanic dust acting as nuclei for the condensation of vapour in the higher strata of the atmosphere will have suggested to many of your readers the probability of so-called cosmical dust being often derivable from similar terrestrial sources. To me it has, moreover, recalled an hypothesis on the origin of meteorites, put forth some twenty years ago in an elaborate treatise by Mr. P. A. Kesselmeyer of Frankfort-on-the-Maine ("Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft," vol. iii.). Mr. Kesselmeyer contends for the derivation of meteorites from condensation of metallic and other vapours issued from volcanoes; he distinctly supposes those of Eastern Asia as chief sources, and, among other ingenious reasons for these views, he particularly insists on remarkable statistics of geographical and seasonal distribution of stone-falls (NATURE, vol. xvi. p. 558).

I am well aware of the momentous difficulties of this hypothesis, which fails to explain why such masses of vapour (or dust), after travelling for enormous distances, become condensed into solid bodies. On the other hand, there appears to me not to be such a contradiction to astronomical theories as might seem at first sight; the view in question would merely involve the assumption that there are fireballs and fireballs: those which

precede the fall of meteorites being of a distinct nature from those which accompany the periodical swarms of shooting stars, and thereby manifest their cosmical origin. As far as I know there does not exist a connection, which might be expected by the usual theory, between these periodical swarms and increased frequency of stone-falls; on the other hand, it is evident that the late extraordinary manifestations of volcanic activity must furnish a crucial test for the hypothesis in question; if it were right, there must be expected an augmented fall of meteorites to follow this period of dust-spreading. D. WETTERHAN

Freiburg, Badenia, January 5

AMONGST the many interesting points for consideration in connection with the late sunset phenomena is the very general prolongation of twilight produced by them, doubtless from the reflection of the sun's rays from clouds or diffused vapour at a more than ordinary elevation, after the sun had set to all at a lower level. In reference to this subject, Mr. E. Douglas Archibald states that he estimated the height of a *glowing stratum* (*i.e.* diffused clouds) as from ten to thirteen miles; that Miss Ley, from calculation, had given thirteen miles as the height of a similar cloud, and in continuation he says:—"I think this height is far more probable than forty miles, as calculated by Prof. Helmholtz. Besides, can we imagine either vapour, or volcanic dust, or a mixture of both, to be capable of remaining in suspension in the air of such tenuity as must exist at such an altitude?" (NATURE, December 20, 1883, p. 176). To this question I would reply by another, and ask if we can imagine vapour or volcanic dust to be capable of remaining in suspension in air of some 17,000 times less density than water, as, at thirteen miles, high, that is about the calculated comparative density of the two.

Or I will go farther, and ask if any one can imagine that water, which is about 860 times heavier than the air at sea-level, can be suspended in the atmosphere without the aid of some buoyant power.

A theory on the cause of rain, storms, the aurora, &c., which I submitted to the British Association at the Glasgow Meeting, 1840 (see Report), was briefly as follows:—

That, as electricity coats the surface of all bodies, occupies space, and has no weight, in evaporating, the minute particles of water take up electricity in accordance with their surface and temperature, and are buoyed up into the atmosphere by it, where, if condensed (*i.e.* cooled), their capacity for electricity is reduced, and the surcharge is retained or passes away in accordance with the conducting or non-conducting state of the atmosphere. I cannot go further into particulars in this paper, but I may say that I have no knowledge of any phenomenon connected with the cause of rain which is not explicable in accordance with the theory, although forty years' exertion has not enabled me to bring it fairly under consideration.

In my first paper I suggested, as a test for the theory, that conductors should be raised from the earth to the regions of the clouds, under the idea that the withdrawal of electricity by this means would produce rain in temperate, and the aurora in frigid regions. And I hold that I am fully borne out on both these points by Prof. Lemström's grand auroral experiment; as, on the connection being made between the wirework on the top of the mountain and the earth at the foot of it, electric currents were observed, the aurora became visible, and the formation of ice on the wirework was so heavy as to break it down; thus showing that rain would have fallen if the experiment had been tried in a lower latitude. I hold also that the experiment already proves that electricity is the buoyant power of vapour in the atmosphere.

With respect to the undoubted great elevation of vapour and volcanic dust thrown up by the Java eruption, I have long been led to believe that electricity coats the surface of bodies in accordance with their temperatures, and that the non-burning property of superheated metal is from the intense force with which electricity coats the surface, and thus the hand is not actually in contact with the metal when placed upon it; and in the case of effluent high-pressure steam, I believe the particles are so completely wrapped up in their coatings of electricity that they do not touch the object the steam impinges on. Bearing these points in mind, it may easily be imagined that particles of dust or water as vapour, when cast up from a volcano, may be at the highest conceivable temperature, and charged with electricity in a like degree, and that, being driven up by currents of heated air, the particles may rise to an elevation far above that of ordinary vapour, and may remain suspended there, more or less, in accordance with the non-conducting condition of the atmosphere at such elevations. G. A. ROWELL

Oxford, January 2

AMONGST the many interesting questions raised by the discussion on the recent sunsets, not the least interesting is the question of the upper currents of the atmosphere. Mr. Norman Lockyer, in his article in the *Times* of December 8, writes of the presumed translation of volcanic dust round half the equatorial circumference of the earth in six days as being in accordance with our actual knowledge of these currents. There are probably many readers of NATURE besides myself who would be glad to be referred to the observations upon which this statement is founded.

An opinion prevails that, in the rotation of the earth about its axis, the higher parts of the atmosphere must to a certain extent lag behind, thus producing an east wind relatively to the surface of the earth; and if we allow ourselves to adopt this view, we may easily imagine that in the equatorial regions there may exist an upper current from the east having sufficient velocity to meet the case supposed. But can this view be justified? Is it not more reasonable to consider that the whole of the earth's atmosphere rotates with the earth as if it were part and parcel of it? It is difficult to see why it should not do so, unless we suppose a resisting medium occupying the inter-planetary spaces.

It is certainly remarkable how well (on the volcanic hypothesis) the entire observations of the coloured sunsets and associated phenomena agree with the supposition of an east wind sweeping round the earth with hurricane speed in the upper regions of the atmosphere. Not only the observations from the Mauritius, Cape Coast Castle, Brazil, and the West Indies, but even those from the Sandwich Islands and from Australia, may be made to harmonise with this theory, and the dust from Krakatoa may be said to have made "a girdle round the earth" in a fortnight. But in case the theory should prove to be inadmissible, it may be worth while to inquire whether some of these earlier observations may not find their explanation in an earlier eruption of the same volcano. The first eruption of Krakatoa is said to have occurred on May 20, and it is evident that long before the date of the great eruption (August 26) enormous quantities of material had been ejected, vast fields of floating pumice having been met with in the neighbouring seas at various times between July 9 and August 12. GEORGE F. BURDER

Clifton, January 7

ONE feature of the recent sunrises I have not seen described, viz. a large and striking pink semicircle opposite the sun, having a bluish centre. I have only twice seen it well marked, viz. on November 27 and December 15. This seems to be one distinct mark of difference between these sunrises and ordinary ones, inasmuch as I never saw it before, though possibly this may be partly owing to the phenomenon only lasting a few minutes at each time. On November 27 it was at its height at 7.43 a.m. At 7.50 there was only a trace of it left. On December 15 it was at its height at 8.6 a.m. At 8.4 it was very faint, and by 8.16 it had again become so, and was whitish. At 8.6 a.m. the north-western sky was darkish to an altitude of about 5°, and light pinkish purple thence to 10°: so far the appearance was quite ordinary; but on the darkish sky rested the broad half ring, which was pink, but the inner part inclining to salmon-coloured. Being much brighter than the pinkish purple, it obscured it where they crossed. I estimated the radius of its outer edge at about 25°, and therefore its apex was about 30° in altitude. Within the ring was a bluish-white semicircle of about half the radius of the pink semicircle; which was thus 12° or 13° in width. The sky beyond was blue. The phenomenon seemed to be an ordinary cirrus, though this was of an indefinite type; the spaces between its wisps were pretty blue in all parts of the north-western sky, but partook somewhat of its colour. On November 27 there did not appear to be any cirrus, but the semicircle must have been on the film which has been so remarkably coloured during sunrise and sunset. I have noticed traces of this semicircle on one or two other mornings, but so faint that I should not have noticed it if I had not looked for it. I presume that it is of the same character as the pink circle with green or blue centre that has been visible round the sun by day. This also is a phenomenon which I never observed previous to last month; it was most striking about the 26th, but continues to be seen almost daily. This

favours the volcanic dust theory; for it is strange that I should never have noticed it before, if it is of common occurrence; still we know that a phenomenon is more easily seen again after it has once been observed, than seen in the first instance. Can these pink rings be accounted for optically? If they could, would it not throw much light upon the cause of the fine sunrises and sunsets?

With regard to the height of the film which has caused these, I should like to ask whether it is considered proved that the sun is actually shining on it so far into the twilight, or whether the glow may not be caused by reflection from bright sky upon which the sun is really shining. The after-glow among the Alps is clearly caused in this latter way, and not by the sun shining upon the mountains themselves. At the same time, the appearance of cirrus clouds dark against the bright sky, as occurred this morning at about 7.40 a.m., seems to point to the film being far above them. THOS. WM. BACKHOUSE

Sunderland, December 19, 1883

P.S.—This morning the pink half-ring was again conspicuous, only the inner half was nearly white; within was the blue, darkish, as before. It was at its best at 8.10 a.m.

December 20, 1883 T. W. B.

I learned from a Dutch paper (but I forget from which) that a *blue sun* was observed at Paramaribo in the beginning of September (I think it was the 2nd or the 6th).

Stuttgart, January E. METZGER

The following letter appears in the *Times* of Tuesday:—

"A shower of matter having 'a white sulphurous appearance' is reported from the vicinity of Queenstown, Cape Colony, towards the close of November. The appended paragraph, giving an account of the phenomenon, is extracted from a Kimberley (Griqualand West) newspaper of December 1. Taken in connection with the description in your correspondence columns of December 25 of a somewhat analogous shower at Scutari, the paragraph is certainly interesting, and, perhaps, of value to physicists investigating the cause of the recent celestial phenomena. "WALTER CLARK

"Edinburgh, January 3

"'We were informed yesterday of the occurrence at Glen Grey, about twelve miles from Queenstown, of a phenomenon which, while it lasted, nearly terrified the white and native population out of their wits. On the afternoon of Wednesday a thick shower of matter, presenting a white sulphurous appearance, fell in the valley in which this village is situate, and, passing right over it from east to west, covered the entire surface of the country with marble-sized balls of an ashy paleness, which crumbled into powder at the slightest touch. The shower was confined to one narrow streak, and while it lasted, we are told, the surrounding atmosphere remained unchanged and clear, as it had been before. Great noises accompanied the shower, and so frightened the people working in the fields, who at first were under the impression that it was a descent of fire—the white substance glistening in the sun—that on perceiving it they fled into their houses for shelter No damage was caused by what fell, and upon examination of the substance afterwards it was found to be perfectly harmless. At first the little balls were soft and pulpy, but they gradually became dry and pulverised, crumbling at the touch. We have before us a piece of earth on which one of them fell, and the mark left behind resembles a splash of lime-wash or similar matter. It does not smell of sulphur.'"

MR. JOHN TEBBUTT, of Windsor Observatory, N.S.W., writes as follows to the *Sydney Herald*:—The appearance presented by our evening skies for some weeks past has been the subject of general remark. Last evening, the 14th, the sky was almost cloudless after sunset, and the usual brick-red light again made its appearance along the west-south-west horizon. It was reflected apparently from an almost invisible and gauze-like cloud in the higher regions of the atmosphere. About seven o'clock the red glow was at its maximum, when a solitary cloud, whose apparent surface did not exceed ten square degrees, presented itself above it at an altitude of 25°. This cloud, which was at first white, quickly changed to a beautiful green, its borders being of a deeper tint. Of all the cloud phenomena that I have witnessed, it was one of the most remarkable. It retained its green colour for the space of about ten minutes, being all the time subject to much internal commotion. It soon afterwards resolved itself into several cloudlets, and finally disappeared. Two or three other small clouds were visible at the same time, and about the same altitude above the northern horizon, but these were of a gray colour throughout. The eastern sky about the moon was of that deep blue which is frequently observed to surround her when rising during the winter oppositions. Shortly after the dispersion of the green cloud, the ruddy glow gave place to the ordinary pale gray of the twilight, but by half-past seven o'clock the western sky became suffused with red, but this time of a clearer and more aurora-like tint. It did not appear, as in the former case, to be reflected from hazy cloud, and it extended much higher in the sky. This repetition of the ruddy glow on the same evening is a phenomenon which I had witnessed on several occasions during the present month. I remember that many years ago (probably twenty-five) a somewhat similar patch of red light used to make its appearance regularly after sunset in the west-north-west. This phenomenon occurred previously to the commencement of my regular meteorological observations in 1863, and was, I think, contemporaneous with a very dry winter. That the present ruddy skies are not merely a local phenomenon is obvious from the fact that they have been regularly observed during the past three months over a considerable portion of the Indian Ocean.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The following appointments have been made in accordance with Grace No. 19, confirmed on December 6 last:—J. H. Randell, B.A., Pembroke College, Assistant Demonstrator in Physics; J. C. McConnell, B.A., Clare College, Assistant Demonstrator in Physics; R. H. Solly, Demonstrator in Mineralogy, and Assistant Curator of the Museum; Walter Gardiner, B.A., Clare College, Demonstrator in Botany; A. Sheridan Lea, M.A., Trinity College, Senior Demonstrator in Physiology; W. D'Arcy Thompson, B.A., Trinity College, Junior Demonstrator in Physiology; A. Harker, B.A., St. John's College, Demonstrator in Geology. Baron Anatole von Hügel has been appointed Curator of the Museum of General and Local Archæology.

SCIENTIFIC SERIALS

THE *American Journal of Science*, December, 1883.—Some points in botanical nomenclature, a review of "Nouvelles Remarques sur la Nomenclature Botanique," par M. Alph. de Candolle, Geneva, 1883, by Asa Gray. The main object of this very valuable contribution to the vexed subject of botanic nomenclature is to enforce the principles and supplement the data supplied by M. de Candolle in his epoch-making work. His doctrines are on the whole cordially accepted, and often very ably illustrated, while here and there some useful suggestive remarks and criticisms are offered on matters of detail upon which diversity of opinion and practice still prevails.—Precarboniferous strata in the Grand Cañon of the Colorado, Arizona, by Charles D. Walcott. The results are here embodied of over two months' careful examination especially of the Kaibab Division of the Grand Cañon and lateral gorges undertaken during the winter of 1882-3. The author, an active member of the United States Geological Survey, concludes that the Grand Cañon and Chuar groups correspond to that of the Keweenawan of Wisconsin, both being referable to the Lower Cambrian. Jointly with the Paradoxides horizon of Braintree, Massachusetts, and St. John's, New Brunswick, the olenellus of Nevada, Vermont, New York, and Newfoundland, and the Potsdam series of Wisconsin, New York, Canada, &c.; they constitute the Cambrian age as so far determined in North America.—Contributions to meteorology, nineteenth paper, with three plates, by Prof. Elias Loomis. This paper deals at some length with the barometric gradient in great storms. The results confirm in a general way the accuracy of Ferrel's formula:—

$$G = \frac{1076{\cdot}4\ (2n\cos\psi + v)\,sP}{\cos i\,(1 + {\cdot}0041)\,P'},$$

where G denotes the barometric gradient in millimetres per degree of a great circle, or sixty geographical miles. But it is shown that the effect of friction is considerably greater than was supposed by Ferrel.—A brief study of Vesta, by M. W. Harrington. The author considers it probable that this asteroid has a

diameter of over 500 miles, that she resembles the moon in her albedo, hence lacks an appreciable atmosphere and water, that the irregularities of her light indicate a very rough surface and rotation on her axis; lastly, that what is true of Vesta is likely to be true, *mutatis mutandis*, of the other asteroids.—On a new form of selenium cell and some electrical discoveries made by its use, by Charles E. Fritts. This new form of selenium cell has the following properties:—(1) its resistance can be made as low as desired, down to nine ohms; (2) the light is made to strike the cell in the same plane as the current; (3) it is far more sensitive to light than any before known, one cell having had fifteen times as high resistance in dark as ordinary diffused daylight in a room. Since the paper was written, the author announces the discovery of a new form of selenium, quite colourless and transparent, obtained under conditions excluding everything but selenium.—The Ischian earthquake of July 28, 1883, by C. G. Rockwood, jun. The author concludes that this disturbance had its orgin in a rupture taking place along an old volcanic fissure running roughly north and south, and extending radially under the northern slope of Mount Epomeo; and that the cause of the increased tension resulting in this rupture must be referred to the residual volcanic activity which Ischia shares with the adjacent mainland, rather than to any merely local subsidence, as suggested by Prof. Palmieri.

Annalen der Physik und Chemie, Bd. xx. No. 11, 1883.—R. Clausius, on the theory of dynamo-electric machines. This is a remarkably clear and able paper, dealing with the fundamental points in the theory of dynamo-electric machines in a masterly way, and introduces several new notions requiring the determination of the arbitrary constants in different machines. The questions of self-induction and mutual induction between different segments of the armature receive special attention. The author promises a further paper with applications of the equations.—L. Sohncke and A. Wangerin, on interference-phenomena in thin and particularly in wedge-shaped films. This paper is a continuation of one in last month's issue, giving new fundamental formulæ for Newton's rings and other interference-phenomena of thin films.—B. Hecht, on the determination of the axis-ratios of the elliptic paths in elliptic polarisation in quartz. A discussion of formulæ of Cauchy, Lommel, Voigt, and Jamin, in reference to the author's experiments.—W. Voigt, on the theory of light: a polemic against Herr Lommel respecting the latter's views on the possible intermolecular friction of the luminiferous ether.—H. Wild, on the application of his photometer as a spectrophotometer; this instrument, constructed by Hermann and Pfister, of Bern, contains a slit, a calc-spar rhombohedron, a Foucault prism, a second rhombohedron, a selenite plate, a Nicol prism, a pair of adjustable glass prisms, a 5-prism Amici direct-vision prism, and sundry lenses. The light to be examined has to pass through these successively.—Researches on forced vibrations of plates; part ii., on vibrations of square plates, by A. Elsas. This paper, which is accompanied by a set of forty-nine figures, is in continuation of a previous research on forced vibrations of round plates. The author points out that we already have the well-known researches of Chladni and Wheatstone on the figures due to natural vibrations of such plates. The aim of this research was to ascertain whether Savart's rule, that the forms of the forced vibrations merge into one another by a perfectly continuous series of modifications, is true for square plates; whether the figures corresponding to forced vibrations agree with those of the free vibrations of the same pitch; and whether the legitimacy of Wheatstone's method of superposition is confirmed or disallowed. The most important of all the results is that it is impossible for a square plate to vibrate in response to any time whatever, higher than its own fundamental, that may be forced upon it.—On Boltzmann's theory of elastic reaction, by Prof. E. Riecke; a mathematical discussion of Boltzmann's equations.—On aqueous solutions, by J. A. Groshans. A discussion of the dependence of the density of the solution on the quantity and molecular constitution of the soluble substance.—Measurement of the quantity of electricity produced by a Zamboni's pile, by Prof. E. Riecke. The values were calculated from currents traversing a long-coil galvanometer and a very high resistance.—On the galvanic-temperature coefficients of steel, rod-iron, and cast-iron, by V. Strouhal and C. Barus. For steel this coefficient diminishes as the hardness of tempering increases, while the specific resistance increases with the hardness. Glass-hard steel has about three times the specific resistance of soft steel.—On the relation between viscosity and electric resistance of solutions of salts in various solvent media, by E. Wiedemann. There appears to be no such relation as has been conjectured to exist.—On Arabian measurements of specific gravity, by E. Wiedemann.—Simplifications in experimenting with the air-pump, by K. L. Bauer, suggests the expedient already well known in England, of placing a sheet of soft caoutchouc under the receiver of the pump instead of greasing its rim; also similarly between the edges of the Madgeburg hemispheres. Gutta-percha paper is suggested as a substitute for bladder to be burst by air-pressure.

SOCIETIES AND ACADEMIES

LONDON

Chemical Society, December 20, 1883.—Dr. W. H. Perkin, F.R.S., president, in the chair.—The following gentlemen were elected Fellows of the Society:—W. P. Bloxam, A. Cobb, J. C. Chambers, A. E. Ekins, F. P. Haviland, F. Keeling, W. H. R. Kerry, J. J. Pilley, M. Percy, J. Phillips, A. W. Rogers, W. J. Saint, G. Smith, A. Smithells. The following papers were read:—Researches on the gums of the arabin group, by C. O'Sullivan. Part I. Arabic acid; its composition, and the products of its decomposition. In this most important paper the author has studied the action of dilute sulphuric acid upon arabic acid. The arabic acid was prepared by the method of Neubauer, and the sulphuric acid was allowed to act for various lengths of time from fifteen minutes to several hours. The molecule of arabic acid, $C_{89}H_{142}O_{74}$, is broken down, a series of eleven acids of gradually decreasing molecular weight (differing by $C_6H_{10}O_5$) having been isolated, and the barium salts formed and analysed; the lowest acid is $C_{23}H_{38}O_{22}$, and is comparatively stable; these acids the author calls α, β, &c., arabinosic acids. Simultaneously a series of sugars having the composition $C_6H_{12}O_6$ is formed of gradually decreasing optical activity, which the author names α, β, γ, and δ arabino-ε. Arabic acid is the chief constituent of all the lævorotatory gums, but other acids are present which bear a simple relation to it. In a future paper the author promises an account of the dextrorotatory and optically inactive gums, the acids of which are built up in the same manner as arabic acid.—On the decomposition of ammonia by heat, by W. Ramsay and S. Young. This decomposition commences about 500°, and is nearly equal in extent with porcelain, glass, iron, and asbestos, but at 780° ammonia is almost completely decomposed by passing through an iron tube. Copper, when heated, is not so active.—On the halogen compounds of selenium, by F. P. Evans and W. Ramsay.—On the preparation of pure chlorophyll, by A. Tschirch. This substance is obtained by the action of zinc dust on chlorophyllan (*Bot. Zeit.*, 1882, 533); its spectrum is identical with that given by living leaves.

Zoological Society, December 18, 1883.—Prof. W. H. Flower, F.R.S., president, in the chair.—Dr. F. Leuthner read an abstract of a memoir which he had prepared on the Odontolabini, a subfamily of the Coleopterous family Lucanidæ, remarkable for the polymorphism of the males, while the females remained very similar. The males were stated to exhibit four very distinct phases of development in their mandibles, which the author proposed to term "priodont," "amphiodont," "mesodont," and "telodont." These forms were strongly marked in some species; but in others were connected by insensible gradations, and had been treated by the earlier authors as distinct species. The second part of the memoir contained a monograph of the three known genera which constitute the group Odontolabini.—Mr. E. B. Poulton, F.Z.S., read a memoir on the structure of the tongue in the Marsupialia. The tongues of species of nearly all the important groups of this subclass were described in detail. It was found possible to classify the tongues in three divisions. Of these, *Halmaturus* was the type of the lowest, *Phalangista* of the intermediate, and *Perameles* of the most advanced, division.—Mr. J. Wood-Mason, F.Z.S., read a paper on the Embiidæ, a little-known family of insects, on the structure and habits of which he had succeeded in making some investigations during his recent residence in India. He came to the conclusion that the Embiidæ undoubtedly belong to the true Orthoptera, and are one of the lowest terms of a series formed by the families Acridioideæ, Locustidæ, Gryllidæ, and Phasmatidæ.—Mr. G. A. Boulenger, F.Z.S., read an account of a collection of frogs made at Yurimaguas, Huallaga River, Northern Peru, by Dr. Habnel. The collection contained examples of eighteen species, eight of which were

regarded as new to science.—Mr. W. F. R. Weldon read a paper on some points in the anatomy of *Phœnicopterus* and its allies. An account was given of the air cells of the Flamingo, which were shown to differ from those of Lamellirostres, and to agree with those of Storks (1) in having the præbronchial air-cell much divided, (2) in the feeble development of the posterior intermediate cell, and (3) in the great size of the abdominal cell. The pseudopiploon was also shown to differ from that of Lamellirostres, and to agree with that of Storks, in extending back to the cloaca. A detailed comparison between the muscles, especially those of the hind limb, gave the same results. The larynx, however, being Anserine, and the skull intermediate, the position expressed by Huxley's term "Amphimorphæ" was considered fully justifiable.—Mr. Sclater read a paper, in which he gave the description of six apparently new species of South American Passeres.

Anthropological Institute, December 11, 1883.—Prof. Flower, F.R.S., president, in the chair.—The election of Mr. E. W. Streeter was announced.—Mr. Walton Haydon exhibited some photographs of North American Indians.—A paper by Mr. A. W. Howitt, on some Australian ceremonies of initiation, was read by Dr. E. B. Tylor. The ceremonies described by the author are common to a very large aggregate of tribes in the south-eastern part of Australia, and as himself an initiated person, Mr. Howitt has had unusual opportunities of observation and of obtaining information from the Blacks. When it has been decided that there is a sufficient number of boys ready for initiation, the headman sends out his messenger, who travels round to the headmen of the same totem, who then communicate the message to the principal men of the different totems which form the local groups. The messenger carries with him, as the emblems of his mission, a complete set of male attire, together with the sacred humming instrument, which is wrapped up in a skin and carefully concealed from women and children. The ceremonial meeting having been called together, that moiety of the community which called it prepares the ground and gets all ready for the arrival of the various contingents. Mr. Howitt then described at length the procession from the camp to some retired and secret place where the ceremonies are to be performed, each novice being attended by a guardian, who fully explains to him all that is said or done. A camp is formed when the spot is reached that has been fixed upon for the site of the tooth-knocking-out ceremony, which was fully described by the author in the latter part of the paper.—Dr. R. G. Latham read a paper on the use of the terms "Celt" and "German."

Geological Society, December 19, 1883.—J. W. Hulke, F.R.S., president, in the chair.—Rev. W. R. Andrews, Robert James Frecheville, and Rev. Philip R. Sleeman were elected Fellows of the Society.—The following communications were read:—On some remains of fossil fishes from the Yoredale series at Leyburn in Wensleydale, by James W. Davis, F.G.S. —Petrological notes on some North-of-England dykes, by J. J. H. Teall, M.A., F.G.S. The author described the stratigraphical relations and the structure, macroscopic and microscopic, of a number of dykes which occur in the north-east of England, giving analyses. He pointed out that they fell into four more or less distinct groups: (1) the Cleveland dyke and that of Acklington; (2) the Heth and its related dykes; (3) the dykes of Hebburn, of Tynemouth, of Brunton, of Hartley, and of Morpeth; (4) the High Green dykes. Groups (1) and (3) resembled one another in specific gravity and chemical composition, as did (2) and (4), the percentage of silica in the first two (except in the Morpeth dyke) varying from 57 to 59, and the specific gravity being about 2·7 or 2·8, while the others had a silica percentage of from 51 to 53, and a rather higher specific gravity. The former present some microscopic differences, the latter are very closely related. The Cleveland, Acklington, and Heth dykes have been examined at intervals far apart, and exhibit no variation or relation to the surrounding rocks; so that evidently they have not taken up any appreciable portion of the material through which they have broken. The dykes of Group (3) being probably pre-Tertiary (the author does not himself find it possible to distinguish igneous rocks by their geologic age) would be termed melaphyres on the Continent; but those of (2) and (4) are nearer to the group of diabases. The Cleveland dyke (Group 1) is almost certainly of Tertiary age, and its structure and composition entitle it to the name of an augite-andesite.—The Droitwich brine springs and saliferous marls, by C. Parkinson, F.G.S.

EDINBURGH

Royal Society, December 17, 1883.—Robert Grey, vice-president, in the chair.—Prof. Tait communicated a paper by Mr. A. Campbell, containing the results of additional experiments on the Peltier effect. The results agreed closely with their values as calculated from the thermoelectric diagram.—Dr. Sang read a paper on the problem of the lathe band, and on problems therewith connected.—Prof. Tait read a note by the Astronomer-Royal for Scotland, on Brewster's line Y in the infra-red. The object of the note was to point out that this line, which had been ascribed by some recent observers to air, and therefore omitted from the spectrum, is a true solar line, which has been found to be due to sodium.—Mr. John Murray read a communication by Mr. P. H. Carpenter, on the Crinoidea of the North Atlantic between Gibraltar and the Faröe Islands; with notes on the Myzostomidæ, by Prof. T. von Graff, Ph.D. —Mr. R. W. Felkin, F.R.G.S., gave a very interesting account of the Madi or Moru tribe, from which the flower of the Egyptian army has been drawn.—A paper was also read, on the structure of the pitcher in the seedling of Nepenthes, as compared with that in the adult plant, by Prof. Alexander Dickson, M.D. Prof. Dickson gave the results of his examination of Nepenthes seedlings lately raised in the Edinburgh Royal Botanic Garden. One of the most important points to which he drew attention was in connection with the annulus or rim of the pitcher orifice. In the seedlings this structure is seen even in the pitcher leaf immediately succeeding the cotyledons, and a row of cushion- or button-like glands is to be found just within its inflexed edge. From observing these glands, Prof. Dickson was led carefully to examine the annulus in the adult plant, with the result of his discovering their representatives in a remarkable series of gigantic glands. If the inflexed rim be examined, there is to be found, just above its free edge, a single line of small orifices, alternating with the ridges of the corrugated annulus and with their tooth-like prolongations, when these are present. On dissection, each of these orifices is seen to be the outlet of a canal-like fossa, from the bottom of which a cellular, nipple-shaped body or mammilla projects. This mammilla is the free apex of a gland, the great bulk of which is immersed in the parenchymatous substance of the annulus. These glands vary in length, according to the species, from 1/37 (*N. ampullaria*) to the enormous measure of 1/12 of an inch (*N. destillatoria*, *N. phyllamphora*, &c.). Prof. Dickson could not speak definitely as to the function of these glands, but thought that they probably secrete honey, affording to the insect the last drops just as it is on the brink of destruction! Sir J. D. Hooker, in his address on insectivorous plants delivered at the Belfast meeting of the British Association, had spoken of the pitcher rim as secreting honey, but without making any reference to these remarkable marginal glands.

BIRMINGHAM

Philosophical Society, December 13, 1883.—Peculiar absorption of a compound of iodine by aluminium, by Dr. G. Gore, F.R.S. This paper contains a statement of the discovery of a peculiar fact by the author, viz. that when a sheet of aluminium was simply immersed in a solution composed of 17½ grains of pure iodic acid dissolved in 3½ ounces of distilled water, it absorbed as much as 16 per cent. of its weight of a foreign substance, and emitted a strong odour of iodine. It retained its metallic appearance, although it had become peculiarly rough by corrosion. When struck by a hard substance it emitted a less metallic sound. In several similar experiments the plates gained much more in weight by absorption than they lost by corrosion. By examining the edges of the sheets under a microscope, the sheets were found to be partly disintegrated into thin layers. A variety of other methods were tried, including electrolytic ones, to produce the same effect, but in no instance did the metal emit much odour of iodine, or appear to have absorbed freely a foreign substance. With aluminium immersed in dilute hydriodic acid containing dissolved iodine, similar though much less conspicuous effects of disintegration and emission of odour of iodine were, however, observed. By immersing a sheet of the metal in a solution of bromic acid, the metal did not appear to absorb much bromine. A partial investigation was made of the phenomena. By washing the sheets with water, the water became strongly coloured by iodine, and continued to do so after many washings. Although, after having been washed and dried, they continued to emit a strong odour of

iodine, they did not by immersion in carbonic bisulphide at 60° F., during thirty-six hours, yield any iodine, or impart any colour to that liquid; the absorbed substance was not, therefore, simple iodine. A flat sheet of aluminium varnished on one side, and then immersed in aqueous iodic acid, did not assume a curved shape. A chemical analysis of the absorbed substance has not yet been made.—Reduction of metallic solutions by means of gases, &c., by Dr. G. Gore, F.R.S. This paper is a record of a number of instances in which various solutions of metals were reduced to the metallic state by contact with gases, and different organic compounds. The solutions chiefly employed were those of palladium, iridium, platinum, gold, silver, and mercury, and less frequently those of copper, lead, iron, manganese, chromium, vanadium, and tellurium. The gases used were hydrogen, carbonic oxide, coal gas, and crude acetylene. The organic compounds included both liquid and solid substances; the liquids were amylene, petroleum, benzene, Persian naptha, xylol, toluol, carbolic acid, "petroleum ether," mesitylene, and liquid chloride of carbon, and the solids were paraffin, ozokerite, naphthalene, anthracene, chrysene, elaterite, solid chloride of carbon, &c. By contact with gases the metals were generally reduced in the form of films upon the surface of the liquids, as well as in that of precipitated powder; some of the films produced, both by the contact of gases and by that of non-miscible liquids, were remarkably beautiful, and of a surprising degree of thinness. Amongst the most conspicuous instances of reduction were the following:—a solution of palladic chloride was rapidly reduced by carbonic oxide, hydrogen, coal gas, and amylene. One of terchloride of gold was quickly decomposed and reduced by coal gas, carbolic acid, and amylene. The most beautiful films were those produced by a solution of terchloride of gold, with coal gas or with amylene. Solutions of chloride of palladium were usually more rapidly decomposed than those of chloride of gold. The films of metal thus produced might prove of service in some optical and other physical investigations. It is worthy of consideration also by geologists, whether the reduction of metals to the native state in the interior of the earth may not in some cases have been effected by contact of their solutions with liquid or gaseous hydrocarbons derived from coal and other mineral substances of organic origin.

PARIS

Academy of Sciences, December 31, 1883.—M. Blanchard, president, in the chair.—Action of heat on aldol and paraldol, by M. Ad. Wurtz.—On a white rainbow (Ulloa Circle) observed at Courtenay (Loiret) on the morning of November 28, by M. A. Cornu. This extremely rare phenomenon occurred under atmospheric conditions closely analogous to those described by Bravais in the *Journ. de l'École Polytech.*, xxx. p. 97. The radius appears to have been much shorter than that of the ordinary rainbow.—Mission to Cape Horn: Summary report on the researches made in natural history and anthropology by the *Romanche*, by Dr. Hahn. In the north-eastern islands of Tierra del Fuego acquaintance was made with the Ua people, who present several remarkable peculiarities. Although living on friendly terms and even intermarrying with the more southern Yahgans, they seem to be related in stock and speech rather to the continental Patagonians. They appear even to exceed them in stature, and thus to rank as the very tallest race on the globe.—Note on the tidal curves registered between November, 1882, and September, 1883, by the maregraph at Orange Bay, Cape Horn.—Observations of the Pons-Brooks comet at the Observatory of Nice (Gautier-Eichens equatorial), by M. Perrotin.—Spectroscopic study of the Pons-Brooks comet made with the reflector of 0·50 m. at the Observatory of Algiers, by M. Ch. Trépied. The following results were obtained:—

	Comet		Flame of alcohol
Reading for line D	13·18	...	—
First green line (less refrangible) ...	13·92	...	14·09
Second green line	15·12	...	15·20
Blue line	16·76	...	17·04

showing that in its visible parts the spectrum of the comet is identical with that of a flame of alcohol.—On the multipliers of the linear differential equations, by M. Halphen.—On a means of determining the factor of integrability, by M. W. Maximovitch.—On the generation of surfaces, by MM. J. S. and M. N. Vanecek.—Reply to M. Larroque's observations on the experiments recently made in connection with the study of earth currents, by M. E. E. Blavier.—On the temperature obtainable by means of boiling oxygen, and on the solidification of nitrogen, by M. S. Wroblewski. Reserving a description of his process, the author announces as a first result an approximate temperature of −186° C. When subjected to this intense degree of cold, nitrogen became solidified, falling like snow in crystals of a remarkable size.—On the maximum of solubility of soda, by M. E. Pauchon.—On an incomplete oxygenised monamine (oxallyldiethylmine, by M. E. Roboul.—On the fluorides of sodium, by M. Guntz.—Researches on ptomaïnes and analogous compounds, by M. A. Gabriel Pouchet.—Action of copper on the health of persons engaged in the copper industries; history of a workshop and of a village, by MM. A. Houlès and de Pietra-Santa. The history of this village (Tarn, Durfort) extends over a period of a hundred years, and tends to show that coppersmiths (forgers, braziers, &c.) are on the whole as long-lived if not more so than the agricultural population of the same district.—On the anatomy of a human embryo in the fourth week, by M. H. Fol.—On a new species of the genus Megaptera (*Megaptera indica*) from the Bay of Bassora, Persian Gulf, by M. P. Gervais.—On a rare species of Dolphin (*Orca gladiator*, Gray = *Delphinus orca*, Fab.) recently captured off Tréport, Seine-Inférieure, by M. H. Gadeau de Nerville.—On the vitelline nucleus of the Araneidæ, by M. A. Sabatier.—New ophidological discoveries, by M. Lichtenstein.—On a phenomenon accompanying the red afterglow of the sunsets of December 26 and 27, 1883, at Tortosa (Spain), by M. José J. Landerer.—Terrestrial physics: the Krakatoa catastrophe; velocity of the earthquake waves, by M. Erington de la Croix. From observations made in Ceylon, Mauritius, and other places, the earthquake wave of August 27, 1883, seems to have been propagated across the Indian Ocean at the prodigious velocity of about 550 m. per second, or 2000 km. per hour.

BERLIN

Physiological Society, December 7, 1883.—Prof. Waldeyer brought before the Society the results of investigations pursued by Herr Koganei in his Institute into the histogeny of the retina. It was known that the retina was a development of a vesicular projecting flap of the brain (*Hirnstülpung des Gehirns*), and that this membrane of the eye consisted in its early stages of fusiform cells. Whether there were other cells besides contained in it, how they were developed, and how the different constituents of the developed retina were differentiated, were, on the other hand, all matters of debate. Herr Koganei had now found that in the earliest stages this membrane of the eye was composed of two series of cells, one of fusiform cells on the distal side of the membrane, the other of round cells supplied with caryokinetic nuclei on the proximal side. The fusiform cells were called "fundamental," the round cells "prolific," these latter alone multiplying, as they did, by scission, and furnishing the whole material for building up the retina. The increase in retina elements proceeded therefore altogether from the proximal side, whence the newly-produced cells intercalated themselves into the layer of fusiform cells, all which phenomena entirely corresponded with those of the brain, it likewise growing only by multiplication of cells on the ventricular side. The differentiation of the fusiform cells into separate retina layers began after the ocular chamber was formed by the invagination of its most anterior part which becomes transformed into a double saucer shaped form, or rather it was only the innermost saucer which became the retina, while the outer saucer was converted into the pigment layer, the cells of which were filled with pigment. The differentiation followed a law of quite universal application. In every case it began on the distal side, which, on the invagination of the ocular chamber, became the inner side, and advanced gradually to the outer side of the retina. It began consequently with the oldest fusiform cells, and passed gradually over to the later-formed fundamental cells. As analogous to this was next recognised the membrana limitans interna, with the supporting fibres of Müller. These formed themselves out of the innermost layer of the oldest fusiform cells, which ranged themselves strongly out in a longitudinal direction, and became flattened on their inner end. The basal laminæ (*Fussplatten*) of these cells impinging on each other formed the membrana limitans. Then the layer of ganglion cells appeared, and, almost simultaneously, the layer of optic fibres intervening between the layer of ganglion cells and the membrana limitans. The mode by which the ganglion cells were developed was through the rounding of the fusiform cells and their emission of offshoots. With regard to the layer of nerve-fibres it was ascer-

tained that they developed themselves out of continuations of the ganglion cells. Whether and in what manner they came later into confluence with the optic fibres proceeding from the brain was a point which must be reserved for further investigation. Prof. Waldeyer deemed it not impossible that the optic fibres growing out of the ganglion cells penetrated into the brain, and there merged into the central ganglion. Thereafter was developed the so-called molecular layer. This name had been given to it in consequence of its finely granular appearance under slight enlargement. With the powerful amplification which was now customary it was, however, at the present day, universally recognised as consisting of an extremely fine network of the most delicate filaments. In the middle of this layer Herr Koganei had found a series of round cells which, having issued from fundamental cells, formed the mother-cells of this layer. Since it was now known that cellular protoplasm consisted of a reticular coating and fluid contents, it became intelligible how, from the protoplasm of the series of mother-cells occupying the middle zone, the fine fibrous net of the molecular layer was formed by more vigorous development of the protoplasmic coating and the proportionate reduction of the liquid contents. In the further development of the embryonal retina there now appeared the internal granular layer with the median granular layer, followed, shortly after, by the external granular layer. Both granular layers developed themselves from the fusiform fundamental cells through the latter becoming round and partially emitting continuations. In this manner they formed themselves into ganglion cells, as the granules of the granular layer must be considered. The median granular layer was in the highest probability a layer of fibre-nets intercalating itself, like those of the molecular layer. In the granular layers, besides round and ganglion cells, fusiform cells were also met with. These fusiform cells, by vigorous longitudinal growth, developed themselves into supporting fibres (*Stützfasern*), flattened themselves at their extreme ends, and by superimposition of their terminal laminæ formed the membrana limitans externa. On the development of this last membrane the ganglia or granules of the granular layer began to send continuations outwards striking through the membrana limitans, which, therefore, very soon appeared occupied with the little blunt endings (*Stümpfchen*). These again grew to be granular interior members of the rods and pins that, finally, developed the hyaline external members which were powerfully refractive and cylindrical, or cone-shaped, the last members in the series of the development of retina elements. At this point the fact, of supreme importance to the physiologist, was established, that new-born animals only began to see when the exterior members of the rods and cones were developed. From the foregoing observations, Prof. Waldeyer deduced an important general conclusion, which had equal applicability to the brain as to the retina. The development of the retina demonstrated that all its morphological constituents, the ganglion cells, the nerve fibres, and the supporting fibres were developed from the same fundamental cells. The supporting fibres of the retina, and in like manner the neuroganglia of the brain, must consequently be classed as belonging to the nervous system, and having nothing in common with the ligamental tissue. They were nervous apparatus, which only did not perform nervous functions. In the case of regenerative processes, however, they played an important part. It was known that highly differentiated tissues were not capable of regeneration, which was therefore impossible in the case of ganglion cells and nerve fibres. Supporting fibres and neuroganglia, on the other hand, were capable of regeneration, and, being developed from neurously constituted cells, were also capable of undertaking nervous functions or of further differentiating themselves for those higher functions. This highly important question deserved a very thorough investigation.

VIENNA

Imperial Academy of Sciences, October 11, 1883.—On the genetic formation of the flora of New Zealand, by C. von Ettingshausen.—On isobutyl-biguanidine, by A. Smolka.—On the Diatomaceæ collected by the Austro-Hungarian North Polar Expedition in Franz-Josef Land, by A. Grumov.—On gravitation, by A. Iarolimek.—On the comet discovered by Brooks, by E. Weiss.—On some spectral-analytical researches carried out with the large refractor of the Vienna Observatory, by C. H. Vogel.

October 18, 1883.—On the theory of diffusion of gases; part ii., dealing with the diffusion of a gas into itself, by L. Boltzmann.—On the quantity of work which can be obtained by chemical combination, by L. Boltzmann.—On the forms and chemical composition of the scapolith series, by F. Tschermak.

October 25, 1883.—On roemerite, botryogen, and natural magnesia iron vitriol, by T. Blaas.—Ichthyological contributions, (thirteenth paper), by T. Steindachner.

November 8, 1883.—Contributions to general nerve- and muscle-physiology; xii., on the change of the electromotor behaviour of muscles produced by electric irritation, by E. Hering and W. Biedermann.—Supplement to his paper on the quantity of work which can be obtained by chemical combination, by L. Boltzmann.—On a series of new mathematical principles, by O. Simony.—Report on the French Expedition sent to the Manihiki Islands to observe the solar eclipse of May 6, 1883, by T. Palisa.

November 16, 1883.—On the *rôle* of the inferior asteroids, by F. Chapel.—On the intercellular spaces of the epithelium of the Polmonata, by A. Nalepa.—On the axis of the tail of the comet 1827 III., by T. von Hepperger.

November 22, 1883.—Contribution to general nerve- and muscle-physiology; xiii., on Du Bois Reymond's researches on the secondary electrical phenomena of muscle, by E. Hering.—On the genetic formation of the flora of Hong Kong, by C. von Ettingshausen.—Contributions to the theory of respiratory innervation (fourth communication), by Ph. Knoll.—On the species, sub-species, varieties, and hybrids of the section Ptamica of the Achillea genus, by A. Heimerl.—Contributions to the knowledge of the fishes of the Adria, by E. Steindachner and G. Colombatovic.—Contributions to the knowledge of the chemical composition of starch-granules, by B. Bruckner.

December 6, 1883.—On a vertebral syno-tosis in *Salamandra maculosa*, Saur., by T. H. List.—On the mechanism of the distant action of electrical forces, by T. Odstrril.—Calculation of the altitude of the pole and of the azimuth at the Kremsmünster Observatory, by W. Tinter.—Report on his geological researches carried out in the western Balkan and the adjacent regions, by F. Toula.—Determination of the orbit of the *Russia* planet (232), by N. Herz.

December 13, 1883.—Histological and physiological studies on the organ of taste, by O. Drasch.—On the satellite curves and satellite planes, by G. Kohn.—Struggle of physical axioms, by T. Schlesinger.

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